

ANNUAL REPORT FOR 1973



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN-18

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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INTRODUCTION

The marine fish production in the country reached an all time record of 1.22 million tonnes during 1973. This was contributed by increased catches of prawns, oil sardine, Bombay duck and sciaenids. The landings from mechanised boats also increased considerably during the year.

During the year, the Institute made valuable contributions especially in the field of mariculture. A significant achievement was the successful culture of elvers of the fresh water eel in running water tanks at Mandapam. The elvers about 10 cm in length and 2 grams in weight on an average attained the harvestable size of 35 cm in length and 106 grams in weight at the end of the first year. This success paves the way for the establishment of an eel culture industry in this country. Elvers and cultured eels have great export potential. The successful development of the technique of pearl culture was another outstanding achievement. At the experimental farm at Veppalodai near Tuticorin, pearl oysters were raised on rafts and the nuclei implanted in these oysters produced lustrous pearls within 90 days. Methods for the production of indigenous nuclei were also developed. The technique could lead to the establishment of a cultured pearl industry in the country.

The experiments on farming mussels on ropes in the coastal areas also proved highly successful. It was estimated that a harvest of 60-70 tonnes of mussels per hectare per year could easily be obtained by this method.

For the first time, it was possible to make the marine prawn, Parapenaeopsis stylifera spawn in captivity and the larvae thus obtained were reared up to the mysis stage. This success is of considerable significance in regard to the production of prawn seed for large scale commercial culture.

The culture of seaweeds at Mandapam has also given promising results. Culture experiments on Gracilaria sp. using floating coir frames showed that a yield of 6 kg/sq. metre per year could be obtained.

Objectives of the Institute

The main objectives of the Institute are:

- i) to estimate the catches of the marine fishes and other animals from the seas around India throughout the year by different types of vessels and gears.
- ii) to conduct researches on marine fisheries resources in order to step up their production to the maximum possible extent

- iii) to locate new fishing grounds; to conduct environmental studies in relation to fisheries; and to generate additional resources by mariculture, and
- iv) to recommend measures for the rational exploitation of the various resources.

Organisational structure and changes

During 1973, the Institute has undertaken 30 research projects and an all-round progress was maintained in these projects at the headquarters and the outstations. The scientific work has been carried out by the three divisions of the Institute namely,

1. Fishery Survey and Statistics
2. Fishery Biology
3. Marine Biology and Oceanography

The works of the three divisions have been given in the various sections under 'Progress of research'. The progress in the other activities of the Institute was as follows:

Library:

During the year, Volume 20 (Nos. 1 & 2) of the Indian Journal of Fisheries was published. Volume 3 (Nos. 1 to 4) of the Fishery and Marine Science Abstracts was also published and issued.

About 300 books and 500 new numbers of periodicals were added to the library. As usual the library continued its services of loaning books and periodicals to different Universities, Institutes, States Departments and other interested organisations. Many visitors from colleges and universities made use of the library consistently throughout the year.

List of distinguished visitors:

Headquarters, Cochin

1. T.C. Raghavan, Chief Justice of Kerala (visited the staff of the Institute at the "Open House" and fisheries Fair organised by the Integrated Fisheries Project at Cochin)
2. Shrimathi Sathyavani Muthu, Minister for Harijan Welfare and Fisheries, Tamil Nadu.
3. Dr. D.F.S. Raitt, FAO, Rome.

Regional Centre, Mandapam Camp

1. G. Rangaswamy, Vice-Chancellor, Tamil Nadu Agricultural University.
2. Prof. Dr. Ingold, Mr. G.H. Axin, Prof. Dr. A. Smith and Mr. E.A. Axin, Members of the World Bank Team.
3. Mr. Iran Stopher, Mr. Peter Fry and Dr. S. Krishnaswamy from the Madurai University.
4. Dr. and Mrs. Frederik B. Bang, John Hopkins University Centre for medical research and training.
5. Thavathiru Kunrakudi Adigalar, M.L.C., Tamil Nadu.
6. Dr. H.R. Arakeri, Dr. P. Bhattacharya, Dr. S.K. Mukherjee, Members of the National Commission on Agriculture, New Delhi.

Substation, Karwar:

1. B.P. Kadam, Deputy Speaker, Karnataka.
2. K.T. Rathod, Minister of State for Fisheries, Karnataka.

Research collaboration with other organisations

1. Survey of chank and pearl oyster beds in collaboration with Department of Fisheries, Tamil Nadu.
2. Collection of data on marine biology and oceanography and exploratory surveys conducted in collaboration with the Indo Norwegian Project and Deep Sea Fishing Stations.
3. Survey of seaweed resources of Tamil Nadu coast in collaboration with Tamil Nadu Government and Central Salt and Marine Chemical Research Institute (CSIR).

Advisory/Consultancy service received and provided

Dr. S.Z. Qasim, Director served as a member of:

- i) Faculty of Science, Annamalai University.
- ii) Advisory Committee, Centre for advanced study in Marine Biology, Annamalai University.
- iii) Board of Governors, Indian Institute of Technology, Bombay.
- iv) Board of Studies, Marine Biology and Oceanography, University of Kerala.
- v) Board of Studies in Fisheries and Faculty of Fisheries, University of Calicut.
- vi) Task Force on Marine Survey (Living Resources), Planning Commission.
- vii) Working Group on Prawn Fishing, National Commission on Agriculture.

- viii) Advisory Committee of the University of Cochin.
- ix) Indian National Committee on Oceanic Research (INCOR).
- x) National Commission on Science and Technology.
- xi) The Senate, University of Cochin and
- xii) Board of Studies and Faculty of Marine Sciences, University of Cochin.

Dr. R.V. Nair, Deputy Director served as Chairman and Member Board of question paper setters and Examiners and Board of Studies in a number of Indian Universities.

Dr. E.G. Silas, Senior Fishery Scientist served as a member of the National Committee on Science and Technology subgroup on living Marine Resources.

Dr. K.V. Sekharan, Senior Fishery Scientist served as a member of The Board of Studies and Faculty of Marine Sciences, University of Cochin.

The Institute extended its consultancy service to individuals, scientific organisations and industries and answered hundreds of queries on fisheries problems.

Deputations

Dr. S. Ramamurthy was deputed by the Government for training in marine fisheries under the technical assistance programme for the FAO & NCAA at USA from 8-1-73 to 25-5-73.

Shri K. Nagappan Nayar, Dr. B. Krishnamoorthi and Dr. M.V. Pai were deputed by the Government for an observational tour in the field of marine fisheries under the Colombo plan technical cooperation scheme to Japan from 18.3.73 to 21.4.73.

Dr. P.V. Ramachandran Nair was deputed by the Government to participate in the Second FAO/SIDA Training Course on marine pollution in relation to protection of living resources at Goteborg and Stockholm, Sweden from 31-3-73 to 9-9-73.

Fellowships and Scholarships

Eight Research Scholars underwent training in research under the scholarships scheme instituted by the Government of India, Ministry of Education and Social Service.

One ICAR Senior Fellow and one CSIR Junior Fellow were also doing research during the year.

Conferences, Symposia and Seminars

The Institute participated in the "Open House and Fisheries Fair" organised by the Integrated Fisheries Project during February, 1973.

Finance

The actual expenditure under the budget allotment of the Institute for the financial year 1973-74 has been Rs.12.05 lakhs under Plan and Rs. 29.69 lakhs under Non-Plan.

Personnel

Shri S.K. Banerji, Senior Fishery Scientist retired on 14-6-1973.

PROGRESS OF RESEARCH

FISHERY SURVEY AND STATISTICS DIVISION

Sample survey for estimating Marine fish production and effort expended to get the production.

(FSS/FRA/FS-1)

The total marine fish production in India during the year 1973 was provisionally estimated at 1220,240 tonnes as against 980,049 tonnes during 1972 showing an increase of about 25% as compared to 1972. The landings in 1973 was also the highest being an all time record. The total fish catch increased in all the maritime States of India excepting Pondicherry and Karnataka where the landings declined marginally. A significant increase in the total landings was also noticed in the States of Kerala and Gujarat. The state wise marine fish landings along with the total catch obtained from mechanised and non-mechanised fishing crafts as also the day and night landings are shown in Table I.

From Table I, it is seen that the total fish catch from mechanised fishing crafts (excluding Goa, Andaman and Laccadives) in 1973 increased to 392,575 tonnes from 322,785 tonnes in 1972, showing an increase of about 22%. This was due to higher landings from the mechanised fishing crafts in the States of Tamil Nadu, Pondicherry, Kerala, Maharashtra and Gujarat. Night landing also increased from 66,061 tonnes in 1972 to 119,742 tonnes in 1973 showing an increase of about 81%. Excepting Tamil Nadu and Pondicherry all the maritime States of India recorded significantly higher fish landings in the night. A remarkable feature noticed during 1973 was a significant increase in the landings of both mechanised and non-mechanised fishing crafts and also night fish landings in Kerala.

The total fish catch in West Bengal and Orissa during 1973 increased by about 7,400 tonnes (48%). The total input of fishing effort also increased during the year (vide Table IX). A significant increase in the landings of prawns, lesser sardines, other clupeids, Bombay duck and ribbon fish was noticed. The catch of sciaenids and silver bellies was, however, poor.

In Andhra Pradesh, the total fish landings increased by about 15,100 tonnes (18%), even though the total fishing effort declined during the year. While the landings of cat fishes, prawns, lesser sardines, anchovies and white baits and other clupeids increased significantly, those of mackerel, seer fish, polynemids and Hilga declined.

TABLE I

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State-wise marine fish landings in India during 1972 and 1973 in tonnes

State/Union Territory	By non-mechanised Units		By mechanised Units		Total		Day		Night		Total	
	1973	1972	1973	1972	1973	1972	1973	1972	1973	1972	1973	1972
West Bengal & Orissa	20,457	13,271	2,279	2,059	22,736	15,330	17,484	13,378	5,252	1,952	22,736	15,330
Andhra Pradesh	94,868	79,785	4,676	4,695	99,544	84,480	99,206	84,246	338	234	99,544	84,480
Tamil Nadu	149,447	129,490	32,972	25,663	182,419	155,153	179,279	151,826	3,140	3,327	182,419	155,153
Pondicherry	6,766	8,307	1,916	672	8,682	8,980	8,669	8,967	13	13	8,682	8,980
Kerala	354,610	256,970	93,659	38,648	448,269	295,618	430,861	287,188	17,408	8,430	448,269	295,618
Karnataka	68,578	43,602	22,906	49,074	91,484	92,676	87,708	92,059	3,776	617	91,484	92,676
Madharashtra	43,738	55,506	182,958	164,496	226,696	220,002	163,087	181,530	63,609	38,472	226,696	220,002
Gujarat	70,754	38,368	51,209	37,478	121,963	75,846	95,757	62,830	26,206	13,016	121,963	75,846
TOTAL	809,218	625,300	392,575	322,785	1201,793	948,085	1082,051	882,024	119,742	66,061	1201,793	948,085
Goa					15,740	30,104					15,740	30,104
Andamans					854	780					854	780
Laccadives					1,853	1,080					1,853	1,080
GRAND TOTAL					1220,240	980,049					1220,240	980,049

The total fish landings in Tamil Nadu increased by about 27,300 tonnes (18%) inspite of decrease in the input of fishing effort. The landings of lesser sardines, Anchoviella, other clupeids, flying fish, sciaenids, cat fishes and prawns were significantly higher during the year. The yield of perches, ribbon fish, carangids and other crustaceans was, however, poor.

The total fish catch as well as the fishing effort expended in Pondicherry declined marginally. While the landings of Anchoviella, Thrissoles, sciaenids, soles and silver bellies increased, those of elasmobranchs, lesser sardines, other clupeids, mackerel, prawns and other crustaceans declined.

In Kerala, the total fish landings increased by about 152,650 tonnes (52%) mainly because of higher input of fishing effort. A significant increase in the landings of penaeid and non-penaeid prawns was noticed due to their increased landings from the mechanised fishing crafts. While the landings of oil sardines increased slightly, mackerel fishery suffered a set back. Other fisheries whose landings were comparatively higher were lesser sardines, cat fishes, perches, sciaenids, silver bellies and ribbon fish. The landings of Anchoviella, red mullets and tunnies were, however, poor.

The total fish catch in Karnataka declined marginally, inspite of the increase in the input of fishing effort during 1973. While the landings of mackerel increased slightly, the catch of oil sardine, marginally decreased. The landings of silver bellies, carangids, lactarius, pomfrets, prawns and other crustaceans were significantly higher. The fisheries of elasmobranchs, cat fishes, lesser sardines, sciaenids, ribbon fish, seer fish and soles were however, poor.

In Maharashtra, the total fish landings during 1973 increased slightly although the input of fishing effort was marginally less as compared to 1972. While the landings of Bombay duck, Thrissoles, other clupeids, ribbon fish, sciaenids and elasmobranchs were significantly higher, those of cat fishes, prawns, mackerel, seer fish and Bregmaceros were comparatively poor.

The higher input of fishing effort contributed to the increased total fish catch in Gujarat. A significant increase in the landings of sciaenids, penaeid prawns and seer fish was noticed during the year. The catch of Bombay duck and elasmobranchs was, however, poor.

Variety composition

The marine fisheries of India which consists of more than 200 different species of fish, have been grouped and presented in Table II for the years 1972 and 1973. Table II shows that the principal fisheries

TABLE II

The composition of total marine fish landings in India during 1973 and 1972 (in tonnes)

Sl. No.	Name of fish	1973	1972
1.	Elasmobranchs	44,917	46,237
2.	Eels	3,869	4,509
3.	Cat fishes	52,642	42,443
4.	Chirocentrus	11,090	9,532
5.	(a) Oil sardine	144,395	127,563
	(b) Other sardines	108,523	44,629
	(c) <u>Hilsa ilisha</u>	404	1,409
	(d) Other <u>Hilsa</u>	11,918	12,229
	(e) <u>Anchoviella</u>	25,394	18,699
	(f) <u>Thrissoctes</u>	13,194	11,130
	(g) Other clupeids	35,350	28,490
6.	(a) <u>Harpodon nehereus</u>	64,345	51,570
	(b) <u>Saurida</u> and <u>Saurus</u>	4,049	4,748
7.	<u>Hemirhamphus</u> and <u>Belone</u>	1,110	687
8.	Flying fish	6,388	1,415
9.	Perches	21,513	15,247
10.	Red mullets	3,925	6,004
11.	Polynemids	9,248	7,100
12.	Sciaenids	87,682	40,159
13.	Ribbon fish	53,106	36,225
14.	(a) <u>Caranx</u>	25,298	27,009
	(b) <u>Chorinemus</u>	2,827	2,952
	(c) <u>Trachynotus</u>	189	2
	(d) Other carangids	129	303
	(e) <u>Coryphaena</u>	228	222
	(f) <u>Elacate</u>	529	403
15.	(a) <u>Leiognathus</u>	48,127	32,314
	(b) <u>Gazza</u>	41	78
16.	<u>Lactarius</u>	13,912	7,579
17.	Pomfrets	22,052	19,007
18.	Mackerel	79,423	108,971
19.	Seer fish	19,700	21,210
20.	Tunnies	5,678	5,760
21.	<u>Sphyraena</u>	3,415	2,367
22.	<u>Mugil</u>	3,138	1,559
23.	<u>Bregmaceros</u>	4,213	5,488
24.	Soles	14,642	9,718
25.	(a) Penaeid prawns	136,514	78,361
	(b) Non-penaeid prawns	66,955	85,488
	(c) Other crustaceans	12,508	11,599
26.	Cephalopods	1,394	1,026
27.	Miscellaneous	56,266	48,598
	TOTAL	1220,240	900,049

of India are oil sardine, mackerel, Harpodon nehereus and prawns. These together contributed about 40% of the total marine fish production during 1973 as compared to 46% during 1972. The reduction in the percentage was due to reduced landings of mackerel and non-penaeid prawns during 1973 and also due to unusually heavy catches of non-traditional fisheries like lesser sardines and sciaenids. The landings of oil sardine and Bombay duck increased substantially. As regards other fishes, the yield of cat fishes, Anchoa, Thripos, other clupeids, perches, ribbon fish, silver bellies, Lactarius, flying fish and soles were comparatively higher. However, the landings of elasmobranchs, red mullets, seer fish and Bregmaceros were poor. A summary of the principal marine fisheries is as follows:-

(a) Oil sardine

TABLE III

Landings of oil sardine during the years 1972 and 1973 (in tonnes)

Year	Kerala	Karnataka	Other States	Total
1972	104,426	15,610	7,532	127,568
1973	122,783	15,495	6,117	144,395
Average (1964-1973)	184,868	35,165	2,351	222,384
Percentage (1964-1973)	83.13	15.81	1.06	100.00

From Table III it will be seen that about 83% of the oil sardine catch come from Kerala. This is based on the average for the ten-year period 1964-1973. The fishing prospect of oil sardine for the country as a whole depends on the success of this fishery in Kerala. After a steady increase upto 1968, the landings of oil sardine began to fluctuate between 1969 and 1973. Although the landings during 1973 were slightly higher as compared to 1972, the catch was far below the average of the ten year period 1964-73.

(b) Mackerel

The mackerel fishery of India is based on a single species, Rastrelliger kanagurta and is mainly confined to the coastal waters of the west coast of India between Quilon (Kerala) and Ratnagiri (Maharashtra).

TABLE IV

Landings of Mackerel during the years 1972 and 1973 (in tonnes)

Year	Kerala	Karnataka	Other States	Total
1972	34,516	32,249	42,206	108,971
1973	19,780	35,468	24,175	79,423
Average (1964-73)	28,065	24,463	24,880	77,408
Percentage (1964-73)	36.26	31.60	32.14	100.00

Like oil sardine, the mackerel fishery is equally important for the states of Kerala and Karnataka. The annual landings of mackerel also fluctuate widely. After a steady increase upto 1971, the total mackerel production in India showed a downward trend during 1972 and 1973. While in Kerala the landings were far below the average of the ten year period 1964-73, in Karnataka and in all India level the catch was above this average (Table IV).

(c) Bombay duck

The Bombay duck fishery is based on a single species Harpodon nehereus and is mainly confined to the coasts of Maharashtra and Gujarat. The fish is also caught in small quantities along the West Bengal, Orissa and Andhra coasts.

The Bombay duck fishery in India has been fluctuating between 1964 and 1973 with an average of 73,218 tonnes (Table V). While Maharashtra contributed about 38% of the total Bombay duck production in India, Gujarat's share was 60%. In 1973, the landings in Maharashtra increased; but in Gujarat the catch not only continued to decline but also fell below the average of ten year period 1964-73. Although the total all India Bombay duck production in 1973 was higher as compared to 1972, the catch was below the average for the ten year period 1964-73.

TABLE V

Landings of Bombay duck during the years 1972 and 1973 (in tonnes)

Year	Maharashtra	Gujarat	Other States	Total
1972	21,246	29,011	1,313	51,570
1973	34,179	27,664	2,502	64,345
Average (1964-73)	27,795	43,864	1,559	73,218
Percentage (1964-73)	37.96	59.91	2.13	100.00

(d) Penaeid prawns

The bulk of the penaeid prawns catch come from the states of Kerala, Karnataka and Maharashtra on the west coast of India. West Bengal, Orissa, Andhra, Tamil Nadu and Pondicherry also contribute substantially on the east coast of India. During 1973 penaeid prawns formed about 63% of the total crustaceans landings in India.

TABLE VI

Landings of penaeid prawns during the years 1972 and 1973
(in tonnes)

Year	Kerala	Karnataka	Maharashtra	Other States	Total
1972	35,866	8,058	20,173	14,264	78,361
1973	84,770	8,235	16,894	26,615	136,514
Average (1964-73)	35,339	4,243	15,290	19,070	73,942
Percentage (1964-73)	47.79	5.74	20.68	25.79	100.00

In 1973, Kerala contributed to the highest landings of penaeid prawns which formed about 62% of the total all India production of penaeid prawns. The total catch of penaeid prawns in India during 1973 was also the highest recorded so far. On the basis of the average for the period 1964-73, Kerala, Karnataka and Maharashtra together contributed about 74% of the total production of penaeid prawns in India (Table VI).

(e) Non-penaeid prawns

The non-penaeid prawns are mostly landed in Maharashtra State. During 1973 these formed about 31% of the total crustaceans landings in India.

TABLE VII

Landings of non-penaeid prawns during the years 1972 and 1973
(in tonnes)

Year	Maharashtra	Other States	Total
1972	83,952	1,536	85,488
1973	63,455	3,500	66,955
Average (1964-73)	44,344	2,226	46,570
Percentage (1964-73)	95.22	4.78	100.00

From the average landings for the ten year period 1964-73, it is seen that Maharashtra contribute about 95% of the total non-penaeid prawns landing in India. During 1973, the landings of non-penaeid prawns in Maharashtra declined as compared to 1972. But the catch was above the average landings for the ten year period 1964-73. The same trend is reflected in the total all India catch of non-penaeid prawns (Table VII).

(f) Lesser sardines

The landings of lesser sardines showed an all time record of 108,523 tonnes during 1973. The record catch is due to higher landings of this fishery in the states of Kerala, Tamil Nadu, Pondicherry, Andhra and West Bengal and Orissa.

(g) Sciaenids

During 1973 the landings of sciaenids registered an increase of about 48,000 tonnes which is due to significant increase in the landings in the states of Tamil Nadu, Kerala, Maharashtra and Gujarat. A bumper catch of about 40,000 tonnes in Gujarat was recorded during the year.

(h) Ribbon fish

The catch of ribbon fish registered an increase of about 17,000 tonnes during 1973. Excepting in Tamil Nadu, Karnataka and Gujarat, the landings of ribbon fish increased in all the maritime States of India.

(i) Cat fishes

The landings of cat fish during 1973 showed an increase of about 10,000 tonnes due to higher catches in the states of Andhra, Tamil Nadu, Kerala and Gujarat.

(j) Flying fish

The flying fish fishery is mostly confined to the states of Tamil Nadu and Pondicherry on the east coast of India and practically absent on the west coast of India. The catch during 1973 showed an increase of about 5,000 tonnes, due to higher catches in Tamil Nadu.

SEASONAL VARIATION

From Table VIII it is seen that about 35% of the total marine fish production took place during the fourth quarter. All the States on the west coast of India excepting Kerala State recorded their maximum landings during IV quarter of 1973. In Kerala, however, the maximum landings were recorded in the third quarter mainly due to

bumper catch by mechanised fishing crafts at Neendakara, Fort Cochin, Vypeen and Azhikode. Along the east coast of India, excepting in West Bengal & Orissa, the fishing in general was uniformly spread in all quarters of the year.

TABLE VIII

Seasonal marine fish landings in different states of India during 1973 (in tonnes)

States	I qr.	II qr.	III qr.	IV qr.	Total
West Bengal & Orissa	5,726	1,649	1,773	13,588	22,736
Andhra Pradesh	26,212	22,429	23,404	27,499	99,544
Tamil Nadu	48,528	41,637	44,520	47,734	182,419
Pondicherry	2,931	2,197	2,038	1,516	8,682
Kerala	62,824	71,164	180,040	134,241	448,269
Karnataka	21,925	9,845	8,255	51,459	91,484
Goa	2,500	1,202	1,671	10,367	15,740
Maharashtra	63,002	58,769	23,826	81,099	226,696
Gujarat	28,370	18,860	15,288	59,445	121,963
Andamans	178	191	211	274	854
Laccadives	581	269	246	757	1,853
Total	262,777	228,212	301,272	427,979	1220,240
percentage	21.53	18.70	24.69	35.08	100.00

Table IX shows the total fishing effort in terms of man hours expended in each maritime State by the indigenous boats (both mechanised and non-mechanised) and catch in Kg per man hour during the years 1972 and 1973. It will be seen that for the country as a whole (excluding Goa, Andamans and Laccadives) both the input of effort as well as catch per unit effort during 1973 showed some increase as compared to 1972. Excepting Karnataka State, all the maritime States of India recorded higher catch per unit effort. Kerala, Karnataka and Gujarat States expended more fishing effort on the west coast of India. On the east coast of India, however, only west Bengal and Orissa expended comparatively higher fishing effort during the year.

The choice of unit of effort depends on the purpose for which it is used. The unit 'man hour' is useful from the economic point of view, especially to show if the effort in terms of man hours expended in fishing over the years has increased or decreased. But in fishery biology studies the unit of effort should be such that each additional

unit should increase the instantaneous rate of fishing mortality by about the same amount. For this purpose, it is necessary to collect the data on effort in terms of number of operations of different types of gears. Table X shows the effort in terms of number of operations of unit gear in different maritime States of India during 1973. From Table X it is seen that Tamil Nadu expended the highest effort in terms of number of operations of unit gear during 1973 along the east coast of India. On the west coast of India Kerala recorded the highest effort during the year. The maximum effort was expended during the fourth quarter at all India level (28%). Karnataka and Pondicherry recorded the lowest effort on the west coast and east coast of India respectively.

TABLE IX
Fishing effort in man hours and catch in kg. per man hour

	Effort in 100 man hours		Catch in kg per man hour	
	1973	1972	1973	1972
West Bengal & Orissa	15,590	14,464	1.38	0.98
Andhra Pradesh	38,424	44,092	2.50	1.90
Tamil Nadu	53,936	55,910	3.38	2.77
Pondicherry	2,445	2,696	3.55	3.33
Kerala	69,748	57,106	6.28	5.11
Karnataka	9,360	8,861	7.78	9.41
Maharashtra	27,451	27,614	8.25	7.93
Gujarat	17,695	14,258	6.89	5.31
TOTAL	234,649	225,001	4.98	4.15

TABLE X
Fishing effort in terms of number of operations of unit gear in different maritime States of India during 1973

State	I qr.	II qr.	III qr.	IV qr.	Total
West Bengal & Orissa	128,195	82,565	88,365	268,413	567,538
Andhra Pradesh	547,346	495,619	525,656	562,457	2131,078
Tamil Nadu	876,152	846,423	967,108	947,737	3637,420
Pondicherry	40,514	47,119	65,018	36,665	189,316
Kerala	707,384	563,865	772,873	786,706	2830,828
Karnataka	46,862	81,839	105,403	71,105	305,209
Goa	NA	NA	NA	NA	NA
Maharashtra	175,752	117,421	111,975	187,795	592,943
Gujarat	154,200	129,765	51,586	155,579	491,130
Andamans	NA	NA	NA	NA	NA
Laccadives	NA	NA	NA	NA	NA
Total	2676,405	2364,616	2687,984	3016,457	10745,462
Percentage	24.91	22.01	25.01	28.07	--

NA = Not available

Personnel associated with the projects

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Stock assessment and estimation of potential yields of commercially important fishes (FSS/FRA/ST-1)

The trends in the oil sardine landings were determined. The landings fluctuated between 1% (for the poor season) to 32% (in good season) of the total annual marine fish landings of the country. The landings of Kerala determined the trends in the all India catch of this fish. The value of M has been estimated as 1.12 and that of F has 0.54. On the basis of these values the average annual standing stock of the west coast during the period 1960-1971 has been estimated as 3,90,000 tonnes.

The trends in the mackerel landings for the period 1952-1972 were studied. The catches were found to decrease for about 3-5 years continuously and then rise to a peak. The contributions of the Kerala and Karnataka coasts to the all India mackerel landings were 40% and 38% respectively. During the period 1960-71 the value of M is estimated as 0.9 and that of F as 1.15. Based on these values the average annual standing stock of the west coast was computed as 57,000 tonnes. A special study of the size composition of the catch of mackerel on the Karnataka coast during the years 1965-1970 was undertaken. The gill net catch in the Karwar zone generally comprised different year classes. While some marginal differences or no difference was seen in the mean size of mackerel in shore seine catch in the Gangulli and Karwar zones in 1966-67 and 1969-70 seasons, a significant difference was noticed in these two zones in the 1965-66 season. As regards gill net catch, the mean size of mackerel differed in the Mangalore, Gangulli and Karwar zones during the 5 seasons except in 1969-70.

The trends in the yields of major exploited fisheries of the east coast of India were studied for the period 1952-72. On the West Bengal and Orissa coasts, elasmobranchs, cat fishes, anchovies, white baits, other clupeids, sciaenids, ribbon fishes and silver bellies ^{showed} increasing catch trends. In Andhra Pradesh the fisheries of lesser sardines, other clupeids, sciaenids, ribbon fish, and penaeid prawns are successful and are expected to maintain the same trend in future also at the present rate of exploitation. In Tamil Nadu the catches of cat fishes, other ^{clupeids}, Anchovies, white baits, sciaenids and prawns are expected to increase in the coming few years.

Personnel associated with the project

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FISHERY BIOLOGY DIVISION

Summary of salient findings:

The fishery biology division had laid increased emphasis during the year on the development of mariculture techniques to suit local species and environments. The year 1973 marked the end of the quest in this country for the technology of production of the cultured pearl; the technology was successfully developed by the Division with its own efforts. Edible oyster and milk fish were also taken up for farming and culture, while the work on mussel culture was intensified and extended to new centres. At the same time, due importance was given to the investigations on the major exploited marine fish stocks, with special reference to the evaluation of their characteristics, as also to the work of finding new resources and exploring new grounds. The salient features of the work done during the year were as follows:

1. Development of the technology of the production of the cultured pearl:

The pearl oysters conditioned in cages since 1972, were operated on and the nuclei inserted, and the first lot of cultured pearls was obtained in 25th July, 1973. The technique was further improved and lustrous pearls of good quality were obtained in later experiments.

2. Intensification of mussel culture experiments:

The work done showed that the estimate of production obtained during the previous year (60 tonnes per hectare per year) was reasonable and most probably represents the minimum likely yield.

3. The cat fish resources in the Palk Bay:

Indications are that a major fishery of cat fishes could perhaps be developed in the Palk Bay.

4. The changes in the Bombay duck stock:

Although the Bombay duck fishery improved in 1973, compared to the previous year, it is still causing anxiety in view of the decrease in the average size of the landed fish.

5. Areas of concentration of major pelagic fishes:

The oil sardine shoals appeared to be concentrated off the Kerala coast more than off the Karnataka coast, and there were comparatively older fish in the catches this year than during the last year. On the other hand the mackerel shoals were concentrated more off the Karnataka coast.

6. The prawn fishery of Tirunelveli coast is developing rapidly. The mud bank fishery for prawns near Alleppey was highly successful.
7. The elvers of the fresh water eel, Anguilla bicolor, were cultured successfully in running water tanks. The elvers about 10 cm in length and 2 grams in weight on an average attained the harvestable size of 35 cm in length and 106 grams in weight at the end of the first year. There was practically no mortality or cannibalism.

Researches in hand

Studies on the oil sardine resources of Indian seas (FR/MF/1)

Catch:

Quarterwise oil sardine catch data was studied in comparison with the average catch for five years for the Kerala and Karnataka regions. It was seen that, as compared to the averages, the annual landings in 1973 along these regions were reduced by 33% with relatively greater reduction on the Karnataka coast. When there is a general depletion of the stock this is to be expected, as the Karnataka region is only second in importance in the oil sardine distribution. In spite of above-average sized juveniles supporting the fishery, the reduction in the second half was 38%, thus indicating a fall in recruitment. Since there has been progressive reduction in recruitment in successive years since 1969, it is certain that the stock has thinned down considerably and is now concentrated mostly off the Malabar coast, especially between Calicut and Cannanore.

Catch per units of effort

The fishery was exploited almost exclusively by one particular type of gear at all centres except at Karwar, where in addition to Rampani which contributed to 79 per cent of the catches, the Yendi (smaller shore seines) was also in operation, yielding, but for a fraction, the balance of the catch. The amount of effort got reduced by 41% at Cochin 35% at Vellayil, 23% at Baikampady and marginally at Karwar, but increased by 80% at Ullal compared to the previous year. The catch per unit of effort data showed that current recruitment was more severely affected off the Karnataka coast than off Kerala.

Size composition

The oldest year-classes were represented by modal sizes varying between 160 and 190 mm in January and by June they were at 165 and 195 mm. Subsequently, they were mostly represented by 170 and 180 mm groups. The 1972 year-class started with three major modal sizes at 100, 110 and 120 mm in January; and by the year end had progressed to 150, 160 and 165 mm respectively. The current recruits entered the fishery in July at Calicut and Cochin, in August at Karwar and in September at Mangalore. The modal sizes varied between 75 and 100 mm in July with the dominant ones at 80

and 95 mm at Calicut and Cochin respectively. In August, the modal sizes ranged between 80 and 130 mm the dominant modes being 90 mm at Calicut and Cochin and 115 mm at Karwar. In September, the range of modal sizes was 95 to 140 mm but the major modes were at 120 and 130 mm. During October to December, the modal range was considerably reduced, the size being 140 and 145 mm. Catches at Tuticorin, on the east coast, also showed the same modal sizes during October to December. It, thus appears that those born first in May/June formed the strongest brood of the current year's recruitment.

Maturity:

Fish in partially as well as completely spent conditions were recorded in May and June indicating the commencement of spawning earlier than usual. However, the gonadal picture also suggested that spawning would not have been healthy in view of very extensive atresia both in pre- and post-spawning states. The July-September period registered the adults mostly in stages VII a and VIIb and during the last quarter in stage IIb.

Sex ratio:

At Karwar, but for the dominance of females in August and of males in December, there were no significant differences. At Mangalore, excess of females was noticed in February, April, May and December and of males in July. In the Calicut area the females were generally more numerous. At Cochin the females dominated only in February and October.

Sub-population studies:

Semological and eye protein investigations were initiated at Mangalore. At Karwar, studies on the vertebral count showed that the dominant number of vertebrae is 47 and that there are no significant differences in the mean number between the juveniles and adults.

Forecast:

The earlier forecast that 1972-1973 season would be below normal has been proved correct. The prediction that the 1973-1974 season would be poor also appears to come true as per the returns recorded so far. The fishery in the first half of 1974 is likely to be poorer than that of the corresponding period of 1973.

Personnel:

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Studies on the mackerel resources of the Indian seas (FB/MF/2)

Catch:

The fluctuation in the annual landings depends mainly on the catches of Kerala, Mysore and Goa. Though there was slight improvement in the total landings of Mysore (the catch in 1972 being 32,249 tonnes), there was a marked decline in Kerala. However, the year's season starting from the 3rd quarter showed some improvement over the catch 5,015 and 4,172 tonnes respectively of the 3rd and 4th quarter of 1972 in this State.

Catch per unit of effort:

Shore-seine (Rampan) was the important gear used for mackerel fishing along the Kanara coast. Along Kerala coast boat seine was predominant. However, at Vizhinjam more mackerel is being landed by drift net. The boat-seine which was equally important here in 1972, landed only 32% of the catch of this year.

Compared to the last year, there was 250% increase in the effort at Calicut. At Baikampadi and Cochin it decreased by 24% and 22% respectively. At other centres, there was no marked change in the effort as far as the important gear is concerned. The catch per unit of effort increased 2 fold at Karwar. At Calicut and Vizhinjam there was only slight improvements compared to 1972. On the other hand at Cochin and Baikampady the catch per unit of effort declined roughly by 75%.

Size composition:

The year-class which contributed the major share of catches in September-December 1972 continued to appear in the landings for some time in 1973 also, reaching a modal size of 245 mm in July. Small mackerel belonging to the 1973 year-class first appeared as a fishery during April-July at Vizhinjam. At Cochin and Calicut the new recruits entered the fishery in August and along the Kanara coast it occurred in September. Mackerel, as small as, 35 mm were found in the fishery at Vizhinjam. However, the smallest recruits ranged roughly between 100-150 mm at other places. The year-class which supported the commercial fishery during September-December had the modal size range 160 to 220 mm along the coast.

Maturity:

The fish which were immature (stage II) in the beginning of the year had become mature by the second quarter. Spent fish were found in the landings in the 2nd and the 3rd quarters. The recruits of the year were all immature and in stage I condition. Many of the fish, however, had passed on to stage II by the year end.

Sex ratio:

The sexes were almost equally distributed among the landings except that of an unprecedented preponderance of females, 8 times over the males, at Calicut in January.

Other studies:

Scales studies were continued and the O-ring class dominated the catches in September at Calicut. The opercular bones are being studied for age and growth determination.

The mackerel catch at Port Blair was 7,732 kg in 1973 against 4,487 kg of 1972. The major part of the landing occurred during May-September. There was some mackerel landings in the last quarter also. Both R. kanagurta and R. brachysoma occurred mixed in the catches and their spawning season also seems to coincide.

R. kanagurta, ranged in size between 50 and 320 mm with a major peak at 60 mm and a minor one at 170-180 mm. The size of R. brachysoma ranged between 80 and 270 mm with the mode at 160 mm.

Forecast:

Recruitment was better in 1973 than in 1972 and it is expected that the catch in the first half of 1974 would be better than that in the first half of 1973.

Personnel:

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Studies on prawn resources of the Indian seas (FB/MF/3)

While the catches of penaeid prawns and 'Other crustaceans' recorded significant increase during the year, those of non-penaeid prawns have gone down considerably. The increasing trend in the crustacean landings was reflected in the quantity of prawns and lobsters exported from the country during the year, which amounted to 38,761 tonnes valued at Rs.73 crores as against 32,117 tonnes, valued at Rs.55 crores in 1972.

The state-wise figures of the crustacean landings are given in Table XI. Except for marginal decline seen in Pondicherry, Karnataka and Maharashtra, all the other states recorded increased landings of penaeid prawns. In the case of the non-penaeid prawns a considerable decrease in the landings was noticed in Maharashtra State.

TABLE XI

Statewise landings of Crustaceans (tonnes)

States	Penaeid prawns		Non-penaeid prawns		Other Crustaceans	
	1973	1972	1973	1972	1973	1972
West Bengal and Orissa	2524	1400	487	-	59	3
Andhra Pradesh	8010	4866	812	437	7952	243
Tamil Nadu	4586	4843	1295	148	9430	9515
Pondicherry	73	177	5	5	304	408
Kerala	53953	35007	573	711	2114	135
Mysore	2876	5559	2	17	1039	346
Goa	-	279	-	-	-	11
Maharashtra	17920	20112	63983	83952	507	487
Gujarat	9873	2013	72	218	750	393
Andamans	-	12	-	-	-	-
Laccadives	-	-	-	-	-	-
TOTAL	99815	74268	67229	85488	22155	11541

A significant development that took place in the capture fishery for the prawns is the widespread use of bottom set gill nets for large sized prawns on both coasts of India. Besides, the mechanised fishing boats have started operations in areas hitherto considered not quite suitable for trawling operations. The Tinnelvely coast on south east coast of India is one of the areas where the impact of these developments has shown definite results.

The monsoon prawn fishery of the mud-bank in Kerala during July-August was better when compared with the 1972 fishery and it lasted for a brief period at Ambalapuzha and Azhikode areas.

At Cochin, where prawn fishery was at its peak, the catch-per-hour from the small mechanised trawlers was 28.2 kg as against 15.8 kg in 1972. That such an increase in catch per hour would take place had been forecast in 1972.

The dominant species landed by the mechanised vessels at Cochin area were Metapenaeus dobsoni and Penaeus indicus during the first half of the year and M. dobsoni and Parapenaeopsis stylifera during the second half of the year. At Calicut, Mangalore and Karwar, P. stylifera was the predominant species in the trawl catches. At Veraval, P. indicus and P. semisulcatus were the principal species while at Bombay, M. affinis and P. stylifera dominated the offshore catches. At Tuticorin and Madras on the east coast, P. indicus was the principal species whereas at Mandapam, P. semisulcatus exclusively formed the fishery. M. dobsoni and M. monoceros were the major species at Kakinada.

As forecast already, the prawn catch from the backwaters at Cochin showed an increase of over 170%, the estimated catch being 1540 tonnes as against 898 tonnes in the previous year. The percentage composition of M. dobsoni and M. monoceros showed increase, while that of P. indicus, M. affinis and P. semisulcatus showed decrease. The estimated landings of the Caridean prawn, Macrobrachium idella increased from 31 tonnes during 1972 to 65 tonnes in 1973. No significant change in the size composition of the commercial species of Cochin backwater is noticed in the current year. The average catch rate of prawns in the samples obtained from the stake nets of Thevara (Cochin backwaters) also showed an increase.

Try net collections were continued to be taken from Cochin backwaters to study the abundance of juvenile penaeid prawns which enter and leave the nursery areas. Large scale recruitment of juveniles was noticed during February-June and in October. The juveniles belonging to the genus Metapenaeus contributed over 92% and the rest belonged to the genus Penaeus. M. dobsoni was the predominant species, but during April, July and August, M. affinis was also common.

BIOLOGICAL DETAILS

Penaeus indicus: At Veraval, the trawler catches were dominated by this species. At Calicut, P. indicus in modal sizes between 71-75 mm and 131-135 mm accounted for the bulk of the catches obtained in gill nets. Bigger prawns (156-160 mm) were predominant in the offshore catches at Cochin in the first half of the year but in the subsequent half, smaller sizes (71-90 mm) supported the fishery. In the offshore catches at Tuticorin, the modal size of the species ranged between 163-203 mm in the second half of the year. However, immature specimens in the modal group 128 mm were also found in July and September. The

inshore catch by gill net also exhibited a similar pattern at this centre. The size of the species at Madras ranged from 110 to 165 mm in the bag net catches. At Kakinada, bigger size groups contributed to the fishery during January-August and smaller sizes dominated in the rest of the months.

P. merguensis: In the commercial catches, P. merguensis was recorded only from Karwar and Kakinada. At Karwar, the major portion came from the shore seine catches. The modal size of the species in the shore seine catch ranged between 81-85 mm to 156-160 mm while the modal size of the gill net catches was between 146-150 mm. At some of the southern centres at Karwar, the gill net catches of the species was found falling between 141-170 mm in modal size. Most of the prawns were found to be in the maturing stage. In the trawl fishery at Kakinada, P. merguensis formed only 0.5% of the catches and in the estuarine fishery 0.8%.

P. semisulcatus: This species was predominant in the trawl catches of Mandapam area on the east coast. At Veraval in the west coast, the fishery of the species ranked second in order of abundance. In the inshore catches at Tuticorin, this species amounted to 30 tonnes. At Mandapam, females between 116-165 mm were the dominant group, while males were between 111-130 mm in different months. Females outnumbered males throughout the year except in May and October when both the sexes were equally distributed.

Metapenaeus dobsoni: This species was the most dominant species in the commercial catches from Cochin to Karwar in 1972, whereas during the current year, M. dobsoni dominated at Cochin only. On the east coast, this species dominated in the prawn landings at Kakinada. At Karwar, the modal size of the species ranged from 61-85 mm for males and 86-100 mm for females. Recruitment of smaller size (61-70 mm) was noticed in November. In the stake net catches of Kagal (Karwar) juveniles with modal size ranging from 36 to 65 mm were abundant during February-April and June-November periods. In the trawl catches at Mangalore, M. dobsoni ranked second with better catches during September and December. The modal size seen at 78 and 88 mm in respect of males and females during January/February was found shifted to 98 and 118 mm in September. Entry of smaller size groups (63-73 mm) into the fishery was recorded during November-December. At Baikampady, the indigenous gear landed good catches of the species during July-September. The departmental shore seine operated at Bengre, showed that the fishery for this species was comparatively poor. The modal size varied from 26-30 mm to 56-60 mm, smaller size groups dominating towards the end of the year. At Calicut, bigger size group (96-100 mm) dominated in the fishery during the first quarter. In April and November, juveniles with mode at 56-60 mm appeared in the trawl catches indicating the recruitment to the fishing grounds. Departmental boat seine operated at this centre landed only small quantities of M. dobsoni. At Cochin the species did not appear in the offshore catches in the first quarter. The modal size during April and May were found to be at 93 and 83 mm and 83 and 83 mm in respect of females and males. During

July, only stray specimens were landed. At Kakinada this species contributed as much as 40% of the trawl landings with better fishery in May-December period. Males of 70-90 mm and females of 80-110 mm in total length contributed the bulk of the catches. Bigger size groups were more during May-October. Mature and spent females were found throughout the year with a peak in August-December indicating that it spawns continuously. In the estuarine catches juveniles below 70 mm consisted the catch.

Metapenaeus affinis: This species was present in the commercial landings from Veraval to Calicut on the west coast and Tuticorin and Kakinada on the east coast. At Cochin this species was not available while at Karwar, the landings of the species showed over 300% increase during the current year. At Karwar, the modal size increased from 118 mm in January to 128 mm in December. The shore seine catch of this species at this centre was contributed by 78 mm group. The fishery was erratic at Mangalore and the progression of modes in respect of this was not clear. However, smaller size groups (85 mm) were seen to enter the fishery in March. The juveniles of the species was observed in the estuarine catches at Mangalore, Cochin and Madras.

Metapenaeus monoceros: In the offshore catches of mechanised vessels, the species was observed only at Cochin on the west coast and Kakinada on the east coast. In the inshore fishery, the species was not available in both the coasts. In the estuarine catch the species was noticed from Karwar to Cochin and from Madras to Kakinada. At Cochin, M. monoceros was represented in the trawl catch throughout the year except in October. As usual bigger specimens between 113 and 153 mm were seen during the first quarter of the year. Juveniles (73-118 mm) were found entering into the fishery during April and August. Females generally dominated males. In the estuarine catch at Kagal (Karwar) this species with a modal size falling between 46 to 80 mm; contributed 71.5%. The Korapuzha estuarine catch showed an improvement during the current year. At Cochin, a two fold increase in the estuarine catch of the species was recorded with highest catch in February-May. In the B.V. Palem (Kakinada), estuarine catch, this species form 57% of the drag net prawn catch.

Metapenaeus brevicornis: This species is commercially exploited at Kakinada only where a total quantity of 98 tonnes, forming 12% of the prawn catch were landed by mechanised trawlers. This species occur throughout the year but the peak landings were from April to July and from October to December. At B.V. Palem, the drag net catch amounted to 9 tonnes and the bulk of the catch consisted of juveniles of the species in 40-70 mm group.

Parapenaeopsis stylifera: This species was most common from Veraval to Cochin and was most abundant in the Calicut-Karwar area. At Bombay, the two modes at 88 and 93 mm were noticed for females in September while for males, it stood at 83 mm during the same month. Specimens measuring 83-100 mm had ovaries either in mature or in spent condition. At Versova

(Bombay) the 'dol' net fishery for the species was considerably good. The catch was supported by 60-115 mm size groups. The shrimp trawl catches at Karwar showed over 200% increase. The modal size ranged between 76-90 mm in males and 81-110 mm in females. The shore seine catches at Karwar and Bengre also exhibited the same size groups. The recruitment into the fishing grounds by smaller size groups were noticed during May and December at Mangalore while it was found during April and November at Calicut. At Cochin, catches were recorded during the second and third quarter only.

Acetes indicus and Palaemon tenuipes: Both these species together contributed over 71% of the 'dol' net fishery at Versova (Bombay). While there was slight improvement in the landings of A. indicus, the catches of P. tenuipes showed a decline during the current year. The fishery of A. indicus was mainly supported by 19-35 mm size groups. At Saseon Dock, 15-33 mm size group of P. tenuipes contributed to the fishery. Sharp fluctuations in the sexratio of the species was noticed in the catches.

Larval and juvenile stages of prawns: Regular plankton collections were made from the inshore sea and from the backwaters to study the rate of recruitment of larval and post larval stages of penaeid prawns into the estuaries. The larval recruitment was relatively less in the inshore waters while in the estuary, it was found higher than that of 1972. Larval forms of M. dobsoni were the most predominant item occurring throughout the year while the larval forms of other species were represented in fair numbers. In the backwater plankton, the number of larvae were actually doubled (849 nos.) when compared to the last year record of 404 numbers. The average larval count was 9.6 per haul. A few advanced stage post-larvae of P. indicus was also noticed in this collection.

In the Korapuzha estuary, near Calicut, peak post-larval recruitment was observed in August and larval and post-larval forms of M. dobsoni, M. monoceros and P. indicus were predominant.

Larval rearing in the laboratory: Experiments were conducted to study the possibility of mass culture of one of the important brackish water prawn, Macrobrachium equidens. It was found that the incubation period for this species was 16 days and a mature females breed 6 to 8 times in a season. The ideal medium for mass culture was found to be natural Sea water made out into 20% to 25% salinity. It was observed that 23% of the larvae from a brood developed to 1st post larval stage and the 1st zoea passed through 10 well defined morphological stages. Another caridian prawn, Leptocarpus potamiscus was successfully reared from zoea to juvenile stage.

Prawn culture in paddy fields: The prawn culture activity in paddy fields was observed in Vypeen Islands. A total of 793 and 99 tonnes of juveniles prawns were caught from the seasonal and perennial fields, respectively.

The average catch-rate was found to be at 756 kg per hectare. The percentage contribution of M. dobsoni and M. monoceros in both fields was found higher than that of last year. The fishery for P. indicus experienced a poor harvest and its percentage composition also came down during the current year. Relatively larger size of prawns were caught in the perennial fields. M. dobsoni in their early maturing stages were encountered in small numbers during March, May and December. Recruitment of M. dobsoni (30 mm group) into perennial fields was noticed during the first half of the year.

Forecast: Post-larval recruitment into the inshore region of Cochin was relatively higher in the first three quarters of the year. However, in the last quarter, the normal ingress of postlarvae started by the end of December only in the marine environment. The same trend is seen in the backwater areas also. The total amount of post-larvae in the estuarine plankton was nearly double that of 1972. The outlook for prawn fishery in this area during the coming season seems to be bright.

Personnel:

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Studies on commercially important elasmobranchs resources (FB/OF/1)

Bombay:

The sharks, Carcharias limbatus, Scoliodon sorrakowah, Hemigaleus balfouri, Sphyrna blochii, S. tudes, and Chiroscyllium griseum, the skate, Rhynchobatus djiddensis and the rays Himantura uarnak, H. alcockii, H. bleekeri, Gymnura poecilura and G. tentaculata were the important species of elasmobranchs recorded in the catches. Biological observations were continued on S. sorrakowah. This species is caught in dol nets and the landings were good in March, August, September and November, and poor in other months. The size range was 165-625 mm; the commercial catch was supported mainly by fish of the size range 310-550 mm, which formed about 73% of the landings. The dominant modes were 330 mm and 480 mm for males and 330 and 530 mm for females. The male-female ratio was 1:1.8. Gravid females were observed only in March and November, their size ranging from 530 to 590 mm. The number of embryos was 8, each uterus having 4. In a few gravid females 14 to 16 embryos have also been observed. Among the embryos, males were lesser in number than females. The size of the embryos varied between 20 and 78 mm.

Tuticorin:

The sharks were caught by drift nets, long lines, hand lines and troll lines. The fishery was good in the 1st and 3rd quarters. In the first quarter Rhizoprionodon acutus and S. sorrakowah were landed by drift net and Carcharias sorrah, C. limbatus and Loxodon macrorhinus, by hooks and lines and Galeocerdo cuvieri by hand lines. In the 3rd quarter the long line and drift net catches were composed mainly of L. macrorhinus. In the fourth quarter, troll lines and handlines landed C. sorrah, C. limbatus and Hemigaleus spp. The size range of L. macrorhinus was 505-665 mm with modes at 595 mm in the first quarter, 555 mm in the second quarter, 610 mm in the 3rd and 565 mm in the 4th quarter. Cephalopods, anchovies and crabs formed the main food items. Embryoes in the early stages of development were observed in the 3rd quarter and advanced stages of development in the first and second quarters. In the 4th quarter gravid females were rare.

Mandapam:

Sharks: Of the 30 species of sharks observed in this area, only 5 support a regular fishery in the Gulf of Mannar. These and other important species constituting the fishery are:- Rhizoprionodon oligolinx, R. acutus, Hypoprion hemiodon, Carcharias limbatus, C. bleekeri, Sphyrna lewini, S. blochii and Hemigaleus balfouri. The landings were good in the first and the last quarters. As many fishermen have changed to mechanised fishing for prawns, the landings of sharks in 1973 were lower than during the previous 2 years. In April and May C. limbatus and S. lewini appeared in large shoals and these species formed 40-60% of the total catch at Pamban, and Keelakarai. In R. oligolinx the size range was 270-720 mm. The males reached the maximum length of 630 mm and the females 720 mm. Two modal size-groups, namely 285 mm and 585 mm were dominant in the catches, the former being abundant at Keelakarai and the latter at Pamban. In June-August, gravid females of 631-660 mm size with intra uterine embryos at different stages of developments, were recorded, the number of embryos varying from 3 to 6. In R. acutus the size range was 270-890 mm, the females growing to a larger size than male. Two modal size groups 475 mm and 765 mm were dominant, the former at Keelakarai, and the later at Pamban. Gravid females of 730-840 mm in size were observed in large numbers during the August-December, the number of embryos carrying from 2 to 4. Intra-uterine embryos from other sharks were also collected; the number of embryos was 8-12 in C. limbatus, and 10-14 in S. sorrakowah. In the deep sea shark E. radcliffei the number of embryos varied from 1 to 2; this species has ova-viviparous type of development.

Rays: About 300 tonnes of rays were landed at Mandapam and Rameswaram against about 860 tonnes during last year. They formed 6-17% of the total catch in the different quarters of the year. Gymnura poecilura was the abundant species in all months forming 10-68% of the catch of rays. Himantura alcockii was landed in good quantities from

January to April and August to November, H. bleekeri in February-April and November, Dasyatis disephen in January, June and July and Aetobatus narinari in February. Biological studies were continued on G. poecilura. The disc width varied from 229 to 606 mm in males and 224-1024 mm in females. The size group 281-320 mm was predominant. The size group 521-560 mm was also abundant from January to April and the group 761-800 mm in the March-May and in September. The female were larger in number than the males except in January and November. The food consisted mainly of fishes. The males mature when they are about 400 mm in disc. width and females when about 600 mm disc width. The species breeds throughout the year, and the maximum number of gravid females was observed in April. The number of embryos varied between 1 and 7, their size range being 224-278 mm.

PORTO NOVO:

Biological observation on the sharks Carcharias dussumieri and Sphyrna spp. and the rays, H. uarnak, H. alcockii and D. sephen were continued. C. dussumieri occurred in the 2nd, 3rd and 4th quarters, the important size groups being 550-600 mm, 650-750 mm and 700-900 mm respectively. The maximum size recorded was 1650 mm. Parturition takes place during April-May and young ones of 520-570 mm occur in the landings during this period. The number of intrauterine embryos varied from 4 to 5. Among three species of Sphyrna, only S. blochii was dominant throughout the year, the size range being 910-1630 mm and the dominant size group 1050-1300 mm. The number of embryos depends on the size of the mother and their size varied between 168 and 242 mm.

Personnel:

R.V. Nair, Deputy Director, P. Devadoss, RA, K.K. Appukuttan, RA, K. Prabhakaran Nair, RA, H. Soundararajan, RA, M.E. Rajapandian, RA.

Evaluation of the resources of Bombay duck, anchovies, lesser sardines and other clupeids (FB/OF/2)

Bombay duck: The Bombay duck catch improved in Maharashtra but declined slightly in Gujarat, as compared to 1972. About 14000 fish were measured 10,000 in Maharashtra and 4,000 in Gujarat. The following table gives the size range and average size of the fish at various centres.

Centres	Size range in 1973 (mm)	Average length (mm)	
		1973	1972
<u>Maharashtra:</u> Dehanu	15-330	207	219
	Arnala	150	-
	Vernova	143	167
	Alibag	177	188
	Murud	160	186
	Dabhol	174	169
Gujarat	Nawahunder	195	-
	Jaffrabad	224	-

The dominant size group was less than 210 mm at all centres, during most of the months of the year. The catch was supported by juveniles (immature fish less than 210 mm) from January-March and May and by adults in April, October and November at Dahahu and juveniles throughout the year except June at Versova. For Alibag, Murud and Dabhol data are available only for the premonsoon period, and these show that the catch was supported by immature fish except in May at Murud and February and April at Dabhol. The observation at Arnala, restricted to a period of 3 months, indicated that the catch here also consisted of juveniles. At Jaffrabad in Gujarat, the adults, more than 210 mm in length, formed a good portion of the catches only in December. Thus the study of size composition shows that the fishery was primarily supported mostly by immature fish (juveniles) at all centres.

The table given above also shows that the average length of the fish in the catch in Maharashtra varied from 143 to 207 mm as against 167 to 219 mm in 1972, showing a decrease in size at all centres during the year under report. For all centres (except Jaffrabad in October) the average size is much below the minimum size of maturity namely 210 mm. Thus the overall picture of the size of the fish in the commercial catch indicates that the stock is probably being over-exploited.

The percentage of mature fish in the catches increased at Dahahu but decreased at Versova, Murud and Dabhol in 1973 as compared to 1972. The females were more numerous than the males during all months of the year in the centres in Maharashtra.

Experimental fishing for Bombay duck was conducted twice off Madh in November with a "Dol" bag net having a bigger mesh size than the conventional nets. The view of the poor landings of Bombay duck in October and November the fishermen were reluctant to operate this experimental net, as they would be losing the prawn catch (*Acetes* spp.) also. Seriological and biochemical studies with a view to delimiting the stocks of Bombay duck have been initiated.

Personnel:

S.V. Bapat, JFS, A.E. Kaikini, AFS, J.P. Karbhari, SRA, Alexander Kurian, RA.

Lesser sardines:

Fishery: The following table shows the region-wise landings of lesser sardines in 1973 as compared to the average yield of past 5 years. The provisional estimate of about 107,000 tonnes, representing double the annual average, is a record in the documented history of the fishery. This was mainly due to seven-fold improvement along the Kerala Coast and secondarily to an increase of 36% along the TamilNadu-Pondicherry sea board.

Period	Andhra Pradesh	Tamil Nadu & Pondicherry	Kerala	Other States	Total
1973	11,721	26,559	62,418	6,266	106,964
Average (1968-72)	13,781	19,526	8,304	9,791	51,402
Percentage difference	-15	+36	+652	-36	+108

The fishery was exploited chiefly by gill net and boat seine at Vizhinjam, by gill net at Tuticorin and Waltair and by shore seine at Mandapam. Regarding species composition, S. gibbosa was dominant at Vizhinjam (47%), followed by S. dayi (22%), S. sirm (17%) and S. fimbriata (14%). At Tuticorin, S. albella, S. sirm, S. clupeoides and S. longiceps contributed 38, 8, 5, 1 and 1 per cent respectively. In the Mandapam area, S. albella was more abundant with 57 to 59%, than the only other species of S. gibbosa. At Waltair, the latter formed 74% and S. fimbriata, the remainder. As compared to last year, there was a change in the species dominance in favour of S. dayi at Tuticorin and S. gibbosa at Waltair in the place of S. albella and S. fimbriata respectively. The Dussumieria fishery, but for an interruption during April to July, was good and relatively better on the Gulf of Mannar coast than on Palk Bay coast at Mandapam.

Biology:

S. gibbosa: The adults were represented by modal sizes varying from 120 to 165 mm during the first 3 quarters. The recruits of the year first appeared in March with a modal size of 65 mm, their modal size varied from 70 to 130 mm during the 4th quarter.

S. dayi: The modal sizes varied between 70 and 125 mm during April-August and between 130 and 140 mm in October-December at Vizhinjam, and between 125 and 135 mm during first half of the year at Tuticorin.

S. albella: At Tuticorin the dominant size group shifted from 105 mm in July to 130 mm in December. At Mandapam the modal size range in the fishery of the Gulf of Mannar coast was 70 to 140 mm. In the Palk Bay fishery juveniles of modal sizes varying between 45 and 100 mm were found during March-December, adults of 120-150 mm modal groups were obtained mostly during January-February.

S. sirm: Juveniles of 70 mm modal size entered the fishery at Vizhinjam in February and March. Fishing both at Tuticorin and Vizhinjam was selective and recorded dominant size of 160-200 mm. While only immature fish were landed at Tuticorin observations at Vizhinjam indicated that the species may be an intermitant spawners as maturing gonads were obtained almost throughout the year.

S. fimbriata: At Vizhinjam the last quarter recorded immature fish in modal size between 130 and 150 mm. At Waltair the species were recorded only in December with a modal size of 70-80 mm, having indeterminate gonads.

Dussumieria acuta: In the Mandapam area the dominant sizes were 130/135 mm during the first quarter, 85 to 135 mm during the 3rd and 125 to 135 mm during the last. Maturing/Mature fish were obtained during the first quarter and spent fish in the 3rd quarter. Artificial fertilisation proved successful and development of eggs was followed up to 48 hours after hatching.

Personnel:

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Anchovies

The Stolephorus fishery improved during this year compared to the previous year at Vizhinjam. Although two peak seasons, April-July and September-November were present during this year also, production during latter season was unusually high, forming 88 per cent of the annual catch. Boat seine landed 73% shore seine 3% and gill net 24% of the catch. Stolephorus formed 80% and 30% respectively of the catch of shore seines and boat seines at Waltair. Whereas in the shore seine the catch and catch rates of these fishes were high during January-February and December in the boat seine the catch was high in May and catch rates in December.

At Vizhinjam Stolephorus devisi and S. bataviensis formed 53% and 37% respectively, of the anchovies catch, whereas at Waltair, S. heterolobus formed 80% of the catch and S. bataviensis formed a minor component. S. devisi at Vizhinjam had the size range 42-97 mm with the dominant sizes ranging between 42 and 97 mm with the dominant sizes ranging between 42 and 87 mm in different months; an individual appears to spawn thrice in a season. The length range of S. bataviensis at Vizhinjam was 42-102 mm with the monthly modal sizes ranging between 42 and 97 mm. The length range of this species at Waltair was 42-92 mm with modal sizes ranging between 52 and 77 mm. The sizes range of S. heterolobus at this centre was 42 to 92 mm with modes varying from 44-77 mm in different months.

Personnel:

S.V. Bapat, JFS, G. Luther, AFS, V. Ramamohana Rao, AFS.

Studies on the resources of tunas, seer fishes and bill fishes (FB/OF/3)

Tunas

At Vizhinjam, the tunas catch (56 tonnes) was better this year than during the last year. Drift net (average catch per unit per day 102 kg) and hook and lines (average catch per unit per day 16 kg) recorded 85% and 14% respectively of the catches. October-November was the period of high catch and catch rates. Euthynnus affinis formed 52% of the catch and Auxis thazard 39%. Other species recorded were: A. thynnoides, Sarda orientalis and Thunnus albacares. The size range of E. affinis was 300-679 mm, with modes at 590 mm, 350 mm and 360 mm, in the drift net catches of September, October and November respectively and 570 mm, 490 mm, 330 mm and 430 mm in the hook and line catches of May, June, October and November respectively. Recruitment of the species into the fishery takes place at the size of 300 mm at least twice every year. Maturity stages IV and V were dominant in the drift net and hook and line catches respectively. The length range of A. thazard obtained from drift nets was 260-504 mm, the dominant size group being 350 mm. Maturity stage III dominated the drift net catch.

At Mandapam, about 51 tonnes of tunas were landed from the Gulf of Mannar, the species being E. affinis and A. thazard. The size range of the former was 320-640 mm with the modes at 340 and 570 mm size range of the latter was 315-450 mm with the mode at 430 mm.

At Cochin, the IFP vessels conducted purse-seine operations at irregular intervals. Small quantities of tunas were obtained especially in the fishing areas 9-76/6B and 10-76/1A during February-April. The total catch during February-April was about 2950 kg consisting mainly of Euthynnus affinis of the size range 450-550 mm.

At Minicoy, the total tuna catch amounted to about 488 tonnes, of which about 481 tonnes were landed by the mechanised boats, using pole and line and the rest by non-mechanised boats using trolling lines. October-March was the period of high catch rates for the former and May-October, the period of high catch rates for the latter types of boats. About 97% of the landings of the former consisted of the skipjack, Katsuwonus pelamis and about 2.5% of the yellow fin Thunnus albacares. In the catches of the non-mechanised boats the skipjack formed about 71% and the yellow fin about 28%. The size range of the skipjack was 300-720 mm with modes at 475 mm, 555 mm and 585 mm. About 18% of the catch consisted of males, 15% of females and the rest of indeterminates. Spent and spent-recovering fish were recorded mainly in January-August.

The fishery continued to suffer for lack of bait fishes. The fishermen fear that the removal of the coral reef inside the lagoon may adversely affect the bait fish resources.

Bill fishes

At Vizhinjam, Makaira indica and Istiophorus sp. formed the bill fish catch (22 tonnes) during this year. The former species had the length range of 2000-2316 mm, the maturity state being II. At Mandapam the bill fish catch was about 8 tonnes, the main species being Tetrapturus tenuirostratus and Istiophorus platyperus.

The total estimated catch by drift nets in the Mandapam areas was 464 tonnes of which about 70% was from the Gulf of Mannar and 30% from the Palk Bay. Of the Gulf of Mannar catch, 60% comprised, Scomberomorus commerson, 10% S. lineolatus, and 30% S. guttatus. Of the Palk Bay with the mode at 550 mm (1 year olds) and in the Gulf 415-1025 mm with modes at 475 mm (1 year olds) and 725 mm (2 year olds). S. guttatus from the gulf ranged from 285 mm to 735 mm in size with the mode at 465 mm (2 year olds).

The total mortality in S. commerson stock was estimated as 1.7. There are indications that landings may increase only marginally if fishing effort increases from the present level.

Personnel:

M.D.K. Kuthalingam, JFS, M.S. Rajagopalan, AFS, M. Devaraj, SRA, M.M. Meiyappan, RA.

Studies on the resources of cat fishes, perches, carangids and lizard fishes (FB/DR/1)

Cat fishes:

There was a 36% decline in the abundance of cat fishes in the Waltair region, as seen from the catch rates of the Government of India trawlers (c.p.h. 7.5 kg in 1974 as against 11.1 kg in 1973). Both Tachysurus thalassinus and T. tenuispinis were almost equally represented in the catches of these trawlers but the annual c.p.h. of the former was 3.9 kg and of the latter 3.6 kg. The first and the fourth quarters were highly productive seasons (c.p.h. 21 kg, and 4 kg respectively) for the former and the 3rd quarter for the latter (C.P.H. 6.6 kg) in the trawl fishery.

The non-mechanised boats landed 72 tonnes of cat fishes at Lawson's Bay (32 tonnes of the former, and 40 tonnes of the latter species), with these boats, the hook and line was the most effective gear for T. thalassinus and the bottom set gill net for the T. tenuispinis. The catch rates were maximum in the IV quarter for the former species and in the second quarter for the latter. Boat seines landed both species in the second quarter.

In the Mandapam area, T. thalassinus formed a good fishery in the first half of the year. T. thalassinus formed 38% and T. dussumieri 22% of the annual cat fish catch. Shoals of T. dussumieri appeared in the Palk Bay during September-December, and were exploited by drift nets and trawl nets (purse-seines were not operated). The shoals, oval in shape, were found at a depth of 7-11 metres and distance of 10-13 kms from shore. The possibilities are very strong of developing a major fishery for cat-fishes in the Mandapam area.

The size range of T. thalassinus was 118-435 mm at Waltair and 80-560 mm at Mandapam. The catch consisted mainly of fish less than 350 mm at Waltair and 240-300 mm and 340-400 mm at Mandapam. The peak spawning period is May-July. Females mature and spawn at the size of 360-380 mm (when they are 2 years old). From the data at Mandapam it would appear that males perhaps spawn at the size of 280-300 mm (when they are one year old). T. dussumieri in the catches at Mandapam had the length range 80-700 mm, the important commercial size-groups being 300-380 mm and 560-640 mm. The size range of T. tenuispinis at Waltair was 120-435 mm the landings consisting mainly of fish less than 340 mm in length. In all months females of this species outnumbered males; the breeding season is May-September.

Personnel:

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Perches:

The Karkara, Pomadourys hasta forms 5-8% of the trawl catches along the Bombay-Saurashtra coast. Modes at 135 mm, 185 mm and 235 mm from the local trawl net, barrier-net and shore-seines, and at 435 mm and 535 mm from the big trawls, hook and lines and gill nets were recorded. Otoliths showed no rings in fish below 140 mm, 1 ring in the fish of the size-range 140-226 mm, 2 rings in the 227-346 mm size range, 3 rings in the 347-446 mm size range, 4 rings in the 447-526 mm size range and 5-6 rings in the size range 526-565 mm. The juveniles are mainly plankton feeders and adults carnivorous bottom feeders.

At Madras a total of 2490 kg of Lactarius lactarius was landed by the Govt. of India trawlers, M.V. Meena Gaveshak and M.V. Meena sitara (1090 kg). The highest catch rate of 24 kg/hr was obtained in February from the square 14-80/1B by the former. The other productive areas were: 15-80/1B (23 kg/hr) in September and 14-80/5B (20 kg/hr) in April. In the operations of the other vessel only one area, namely 15-80/2B yielded a comparable catch rate 21 kg/hr also in September. The size range of the fish in the catch was 30-54 mm (fork length).

The Lactarius fishery was poor at Mandapam from January to September. The size of the fish in the catch ranged from 150 to 297 mm. The fish were in advanced maturity stages (IV-VI) from October to December.

Nemipterus japonicus was landed by the trawlers at Cochin, working mainly in the grounds 8-75/B, 8-76/F, 8-77/B, 9-75/F, 9-76/B and 10-76/A, i.e. off Trivandrum-Ponnani. The area 9-76/A, gave the maximum catch. Fishing was done up to 60 m depth by the vessels. The depth-range 40-60 m gave very good catch rates. The length range of the fish was 71-295 mm with two modes the first one varying from 98 to 144 mm in different months and the second from 158 to 183 mm.

Personnel:

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Carangids

At Waltair carangids formed 1.3% of the catches of the Govt. of India trawlers. The 17° 10' zone (south of Visakhapatnam) gave good catch rates (4.7 kg/hr for Meena Shodak and 2.5 kg/hr. for Meena Jawahar). The catches were composed almost exclusively of Garangoides malabaricus. In the non-mechanised boats at Waltair carangids formed 2.7% of the catch, hook and lines accounting for 65% of the carangid landings Chorinemus lysan and Caranx sexfasciatus were the dominant species of these boats. Bottom set gill nets recorded good catches in March, the important species being Megalaspis cordyla and Caranx spp. The length range of Garangoides malabaricus in trawl catch was 120-260 mm the catch consisted mainly of 2 year olds.

At Vizhinjam, the carangids catch improved during this year, compared to the last year. About 50% of the catch was landed in October, consisting mainly of Megalaspis cordyla. The size range of the fish during the year was 53-531 mm with modes at 315 mm in March and 335 mm in November. Juveniles with modes at 105 mm and 125 mm were available in June-August. The annual size range of Decapterus dayi the other important species was 26-305 mm with modes at 185 mm and 190 mm in April and May respectively and at 195 mm from June to November. Juveniles were represented by the modes at 35 mm, 55mm and 115 mm.

Personnel:

B. Krishnamoorthi, JFS, S. Reuben, AFS, P.V. Sreenivasan, RA.

Lizard fishes:

At Madras Saurida undosquamis was the main species of lizard fishes, landed by the Govt. of India trawlers. The size range in the catch was 61-220 mm, the dominant size group being 161-170 mm. The presence of juveniles in the fishery in December was a salient feature.

Personnel:

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Sciaenid and polynemid resources of the east and west coasts of India

(Fb/DR/2)

Sciaenids

At Bombay, the fishery of the major sciaenids, Ghol and Koth, continued to be poor, as the trawlers continued to operate in the comparatively shallow grounds. The ghol, Pseudosciaena diacanthus was landed in good numbers at Bombay during the first quarters; it also formed a fishery in the Gulf of Mannar at Mandapam. The Koth, Otolithoides brunneus supported a good fishery off the Dwaraka-Kutch area. The landings of the minor sciaenids were good at Bombay only during the first and last quarters. At Mandapam the estimated catch of sciaenids by trawlers was 80 tonnes. A distinct difference in the species composition of the catches of Gulf of Mannar and the Palk Bay was noticed. A decrease in the sciaenid catch of the trawlers was noted at Madras also; on the other hand it improved at Waltair, compared to the last year.

P. diacanthus: The dominant size groups in the catches at Bombay were 350-450 mm and 600-800 mm, representing one and two year olds respectively. The catch was supported mainly by one year old fish (410-500 mm) in August and two year olds (810-850 mm) towards the end of the last quarter. Young ghol, measuring 50 mm and below were recorded in June. Spent fish were observed in August-September. The size range at Mandapam was 150-1225 mm with the catches supported mainly by fish of the length groups 1000-1220 mm.

P. sina: The size range at Bombay and Calicut was 35-175 mm. The length weight relationship (AL^n) showed the exponent to be about 3.5. Spawning fish were recorded in offshore areas and spent recovering and juveniles from the inshore area. Fecundity ranged from 1 to 4 lakhs.

P. ^vogleri: The length range at Bombay was 90-369 mm and at Madras 63-168 mm. At Bombay mature fish, were recorded during March-May, whereas they occurred practically throughout the year at Madras.

P. aneus: The length range was 115-234 mm at Waltair, 115-215 mm at Madras and 80-200 mm at Mandapam. At Waltair, the mode at 160 mm in July shifted to 190 mm in August; in October a new brood appeared at a mode of 140 mm which could be traced to 150 mm in November-December. At Mandapam the mode at 75 mm in June shifted to 155 mm by December. Studies at Madras and Mandapam indicate peak breeding in March-April, the offspring attain a length of 75 mm by June, as observed at Mandapam.

Johnius dussumieris: The length range at Bombay and Calicut was 136-210 mm and 95-225 mm respectively. As seen from the occurrence of ripe fish, the species appears to have two spawning seasons. One in January-February and another in November. Growth checks have been recorded in the vertebral centres.

J. carutta: The size was 110-214 mm at Waltair; females outnumbered males.

Otolithus ruber: The size ranged from 70 to 364 mm at Madras and 65 to 305 mm at Calicut. Most of the specimens examined were in early stages of maturity.

O. brunneus: At Bombay, where the fish is being studied, the catches comprised, mainly the 0, 1 and 2 year old fishes. The dominant mode at 385 mm in January was traced to 525 mm in June. In July a new brood at a mode of 175 mm was recorded and it progressed to 315 mm in October.

Personnel:

T. Tholasilingam, FS, S.J. Rajan, AFS, T. Appa Rao, AFS, R.S. Lal Mohan, AFS, K.V. Somasekharan Nair, RA, A.A. Jayaprakash, RA, C. Muthiah, RA, S. Srinivasarangan, RA.

Polynemids

At Mandapam, about 22 tonnes of polynemids were landed by trawlers, the catch being very good during the first and the last quarters. The sub-areas 9-78/1F and 9-79/1A are very productive. At Bombay only the gill net catches were assessed; the main fishing seasons are January to May and August to October.

The catch at Mandapam was supported mainly by Polynemus microstomus. The smallest modal length was 87 mm in June and the highest at 152 mm in December. Small juveniles of the size range 65-95 mm were recorded in June for the first time. Advanced maturity stages were observed in March-June. At Bombay the catch consisted mainly of P. indicus and the modal size was constant at 105 mm during February-May.

Personnel:

T. Tholasilingam, FS, V.M. Deshmukh, AFS, K. Dorairaj, AFS.

Studies on the resources of Silver Bellies, Silver Biddies and Ribbon fishes (FB/DR/3)

Silver bellies:

At Waltair there was a slight decline in the abundance of silver bellies. The annual catch per hour of silver bellies recorded by the Government of India trawlers was about 16 kg, slightly less than that obtained in 1972 (17 kg). High monthly yield rates were realised from the squares 17-83/C5, D5, D6 and E6. The total catch in the non-mechanised boats was also less than that of the last year. At Madras the fishery was fairly good practically all through the year. The trawl nets contributed to the bulk of the monthly catch (85 to 100%), followed by Thuri vala (2 to 16%). At Mandapam the total landings of silver bellies from the Palk Bay during 1973 (about 10050 tonnes) were distinctly higher than in the previous year (7600 tonnes) and, as in the previous year the bulk of the catch (8900 tonnes) was obtained by day fishing. The peak of the fishery was in May-July. The monthly catch per boat per trip for day fishing varied from 1962 to 4585 kg. The wide difference observed in 1973 in the catch during day (8900 tonnes) and during night (1200 tonnes) and the average catch per boat per trip during day fishing (2100 kg) and night fishing (88 kg) confirms the view that there is distinct diurnal migration in silver bellies. The catch rates by day fishing in the Palk Bay has been rising from 1310 kg per boat per trip in 1970 to 2100 kg per boat per trip in 1973. The fishery in the Gulf of Mannar was very poor. The Tamil Nadu Government trawlers fishing in the areas 7-79/1A, 1B, and 3B and 9-78/1F, in the Gulf of Mannar at depths of 12-48 metres in October-December obtained silver bellies at the rate of 425 kg per hour. The Fish Meal Plant at Mandapam received a supply of 1100 tonnes of silver bellies which was almost equal to what it received compared to the last year. The maximum quantity landed was in September and the minimum in January. The boat seines landed the bulk of the catch.

At Waltair, Leiognathus bindus was the major species in the catch and it showed a growth rate of 5 mm per month; spawning in the species appears to take place from October to March. At Madras, Secutor insidiator formed a minor fishery. Spawning in this species take place from January to March. The modal size of Leiognathus jonesi, the major species in the Mandapam area, ranged from 20 to 90 mm the dominant mode being at 80 mm. An interesting feature observed here was that the small sized silver belly occurs in greater proportions in the night catches than the day catches, and fish in the modal range of 20 to 40 mm were not represented in the day catches. Peak spawning in the species is in February-April and September to November. At Vizhinjam the size range of Leiognathus bindus was 19-110 mm. Mature fish were observed in April-June and in September and October. The total length of Secutor insidiator observed in the catch here was 20-102 mm; mature specimens were recorded in April-May and August-October.

Personnel:

G. Venkataraman, JFS, K. Venkatasubba Rao, AFS, C.R. Shanmughavelu, AFS, J.C. Gnanamuttu, AFS, K. Rajasekharan Nair, RA.

Ribbon fishes:

The ribbon fish fishery which was poor during the first half of the year at Madras improved considerably in the next half. The important nets were the trawl net and the bag net. At Rayapuram, high catch rates ranging from 2.6 to 4.2 kg per hour were obtained in trawl nets in September-December, the maximum being in October. At Kakinada, consequent on the increased effort, the ribbon fish catch increased, as compared to the previous year.

Trichiurus lepturus formed the dominant species both at Madras and Kakinada. The size range at Madras was 222-608 mm. The modal groups ranging from 360 to 400 mm and 500-600 mm. At Kakinada the length range of the fish landed was 200-835 mm, the modal length varying from 345 to 525 mm. The catch consisted mostly of 0 and 1 year old fish.

Personnel:

G. Venkataraman, JFS; P.T. Meenakshisundaram, AFS; K.A. Narasimham, AFS.

Evaluation of the demersal resources of some selected areas (FB/DR/4).1. Cochin

The results of the fishing operations by the vessels belonging to the Deep Sea Fishing Station are given below:

	Meena Utpadak	Meena Tarangini	Meena Saudagar	Meena Sangrahaak
Effort (in hr.)	665.16	216	208	311.91
Depth Range	10-60	22-50	20-50	13-50
Total catch (kg)	120889	34996	33069	82750
Catch/hr	181.74	162.02	168.99	265.30

The IFP medium vessels (36-footers 48 HP) and larger vessels (over 200 HP) operated as follows:

Operations by medium vessels:

a) Shrimp trawling, carried out in the shallow-water grounds (9-76/6A, 6B, 10-76/1A, 1B) at depth range of 9-40 m, yielded a catch rate (of prawns alone) that was almost half that of previous year (5.03 kg/hr) in 1973 and 9.96 kg/hr in 1972. The overall catch rate was more or less comparable (36.64 kg/hr in 1972). The category wise details are given in Table below.

Gear	Effort (hr.)	Catch and CPH (in brackets)				Total
		Prawns	Crabs	Elasmobranch	Other fishes	
Shrimp trawl	748.25	3.762 (5.03)	65 (0.09)	856 (1.4)	22247 (29.73)	26930 (35.99)
Purse seine	253.24	68 (0.27)	-	-	123664 (488.28)	123702 (488.55)
Pelagic	299.58	4 (0.01)	-	-	11268 (37.61)	11272 (37.62)

b) Purse seine operations realised a total catch of 123.702kg for an effort of 253.24 (catch rate 488.55 kg/hr), as compared to a catch of 52,865 kg for an effort of 117.5 hr. (rate 449.91 kg/hr) last year. The fishing was done off Cochin at depth range of 9-20 m. The details are given in Table above.

c) Pelagic trawling operations on experimental basis were carried out with two medium vessels operating as a unit off Cochin at depth range of 9-30 m.

Operations by larger vessels:

a) Trawling at a depth of 18-126 m the larger vessels landed a total of 308,942 kg fish for an effort of 1316.57 hr. (catch rate 234.65 kg/hr). The corresponding figures for previous year were 311,633 kg, 1698.67 hr and 183.46 kg/hr).

b) The larger vessels also conducted exploratory lobster trawling in the deep-water lobster grounds off Mangalore, Malpe, Cochin, Alleppey, Quilon, and Cape Comorin and the lobster catch rate, 50.78 kg/hr (see Table below) was low compared to the corresponding value of 104.77 kg/hr in 1972.

Catch and cph (within brackets)							
General trawling	1316.57	482 (0.37)	283 (0.21)	4093 (3.11)	97149 (73.79)	206935 (157.17)	308942 (254.65)
Lobster trawling	250.41	583 (2.33)	12715 (50.78)	-	117 (0.47)	1261 (5.03)	17566 (70.15)

2. Kakinada

During the year the catches were high in the first quarter, moderate in April-May, and poor in the later part of the year. In spite of the two-fold increase in effort this year, the landings showed no proportionate increase, as compared to 1972. The trawl fishery this year was characterised by longer trips by boats to distant fishing grounds (up to 60 km), as the usual shorter trips were found to yield decreased landings. This indicates that the fishing pressure in the traditional grounds is heavy.

The percentage of prawns and CPH have shown a decrease in the present year. Pablos, which landed 428 tonnes of prawns in 1972, landed only 216 tonnes this year, the increase in the fishing effort failing to show any comparable increase in catch. Sorrahs recorded the highest CPH among the three types of boats.

Metapenaeus dobsoni, with an annual landings of 323 tonnes, ranked first in abundance, followed by M. monoceros, M. brevicornis, M. affinis, Penaeus indicus and P. monodon. Although prawns occurred all through the year, the landings were particularly good during the first quarter.

3. Port Blair

Trawling operations were undertaken from January to June. 16,229 kg of fish were landed during the period, for 91 hauls and 154 hours and 47 minutes of fishing effort, with 105 kg catch per hour. New areas namely 10-92/4D, 5D, 5E were covered on the eastern seaboard of the island Little Andaman, in the month of March and 1292/1F, 11-93/6A and 11-92/6F around Neil and Howelock islands in April. Areas 10-92/4D, 5D, 5E show good promise once the thick coral outgrowth on the sea floor is weeded out by continuous operations. The catch per hour in area 10-92/5E is 620 kg. Areas around Neil and Havelock Islands have also ideal trawling conditions. However due to lack of facilities it was not possible to carry out regular operations in these areas.

Maximum catch was landed, 7313 kg, in the month of March, representing 45.06% of the total, followed by January which accounted for 3,346 kg (21.85%). M.T. Matsyavignani, although it operated only for three months contributed 48.61% of the total catch.

Species-wise and group-wise landings by individual vessels showed that elasmobranchs represented a sizeable percentage (31%) in the catches, followed by perches (7.58%). Miscellaneous group, which is constituted by the species not shown separately, makes up for 59.61%.

On the cessation of trawling operations, purse seine operations were undertaken from October to December. The results were, however, very poor due to disappearance of shoals from near-shore waters.

Long lines and trolling lines were operated from August to December. 1023 kg of fish were caught during the period. Of this, sharks represented 74.39%. Non availability of necessary facilities such as ice and water facilities, anchorage in distant waters etc. contributed to the bad performances, of the gear.

It is proposed to introduce trawling to cover the distant northern and southern areas.

Personnel:

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Studies on the resources of flat fishes, pomfrets and eels (FB/DR/5)

Flat Fishes:

The Malabar sole: *Cynoglossus macrostomus*

The landings declined in 1973 at all centres of observation, compared to 1972. At Vellayil (Calicut), the usual August-September peak in the catch of non-mechanised boats, which traditionally accounts for the bulk of the annual yield was absent; this was the main reason for the steep fall in production at this centre. A redeeming feature here was that the catches of the mechanised boats amounting to 94 tonnes represented a 3 fold increase over their landing in 1972. The catch per unit of effort of the mechanised boats was 9.9 kg (13.6 kg during the last year) at Mangalore and 12 kg (46 kg in 1972) at Malpe. At Ullal, the catch by non-mechanised boats amounted only to 400 kg, the entire quantity having been landed in October. Both at Mangalore and Malpe the catches of the mechanised boats were good during January-May and September-October as during last year, whereas at Vellayil the peak catches and catch rates of the mechanised boats were recorded in October-December. The studies further indicate that whereas mechanisation has led to a marked expansion of the fishery to the non-traditional season in the Mangalore-Malpe area, such an effect is still to be felt in the Calicut Areas.

The size range at Vellayil was 30-170 mm with the catches contributed largely by fish of the size groups 50-80 mm and 120-140 mm. The size range was 65-164 mm at Mangalore with the modal sizes varying from 112-137 mm in different months, and 70-154 mm at Malpe with the modal sizes varying from 92 to 137 mm during January-May. During the first and second quarters the fish were mostly immature. In October-November maturing fish were dominant in the catches; spent fish along with a new brood of juveniles appeared in November-December. In the Mangalore-Malpe area spent fish were recorded in April and ripe fish in December; males were more numerous than the females in the catches.

Other flat fishes

At Vellayil the catch of the tongue sole C. dubius amounted to about 2.3 tonnes in 1973 as against 0.1 tonnes in 1972, the bulk of the catch having been landed in December.

Personnel:

G. Seshappa, FS; A.C.C. Victor, RA

Pomfrets:

The pomfret Pampus argenteus formed 8-10% of the total fish catch at Veraval, Mangrol and Navabandar (Gujarat). At Veraval about 380 tonnes of pomfrets were landed by gill nets and about 41 tonnes by trawls. About one-third of the catches were landed in November. The average catch per gill net per day was about 4 kg. At Mangrol the average catch per gill net per day during January-April was 10-15 kg. At Navabandar, only juveniles were recorded in the trawl net catches, the catch per unit being about 5 kg during February-April. The size range and modes of fish in the catches were; At Veraval: 116-360 mm (the modes varying from 193 to 318 mm in different months); At Mangrol: 201-295 mm (the modes varying from 248 to 263 mm in January-February); At Navabandar: 77-165 mm (mode at 148 mm in November). A record specimen of P. argenteus landed at Porbunder in April had a length of 420 mm and weight of 1.75 kg. It was a female in final stage of maturity. The stomach was full, containing 36 ml. semidigested food consisting mainly of crustaceans.

Personnel:

G. Seshappa, FS; Kuber Vidyasagar, SRA.

Eels

The fishery for the eel Muraenesox telabonoides was good in the Bombay area during January-April and October-December. For biological studies about 1200 specimens were collected. The fish being very long, the hinder part of the body tends to be susceptible to injury due to the attack of predators or due to other causes and therefore the actual length of such specimens cannot be obtained. From the measurements available it is seen that the catches comprised of the length range 41.5 to 212 cm. Four modal size groups were observed; the first one varying from 45 to 95 cm during different months, the second from 75 to 105 cm, the third from 135 to 165 cm and the fourth, found only in May, at 155 cm. Otoliths revealed the presence of two rings in fish of the size range 61-110 cm, three rings in the size range 110-137 cm and five rings in the size range 150-178 cm. Fishes, crustaceans and cephalopods were the main food items. April-May appears to be a breeding season. Because of the lack of sufficient data after June the occurrence of the second breeding season as reported by earlier workers would not be confirmed.

Personnel:

G. Seshappa, FS; M.Z. Khan, RA.

Studies on other crustacean resources (FB/MISC/1)

Spiny lobster:

The fishery for the Indian spiny lobster, Panulirus homarus was exceptionally good during this year in the Kanyakumari district (Tamil Nadu). The total number of lobster landed at 23 observation centres in the district was 1,25,826 during the period January-May and October-December. The size of the lobster ranged between 85 to 277 mm with modal size at 155 mm and 165 mm for males and females respectively. Around Tuticorin, investigations on the lobster fishery was initiated in July. Three species, Panulirus homarus, P. ornatus and P. versicolor were caught in the harbour region of Tuticorin.

Deep Sea spiny lobster:

The fishery for the deep sea lobster, Puerulus sewelli was confined to February, March and June. They were mainly caught off Quilon and Cochin, the major portion being harvested from 216-253 m depth. The modal size of males and females was respectively 155 mm and 145 mm. Berried females were more abundant during January and February.

Commercially important crabs

Scylla serrata

The estimated catch of this estuarine crab at two observation centres at Kakinada amounted to 29.6 tonnes which is higher than that of the previous year. Crabs with 170-210 mm carapace width contributed to the fishery. At Cochin, 3.1 tonnes of this species was landed from one observation centre. The size of the crabs ranged from 46 to 184 mm with modal size 101-110 mm for males and 111-120 mm for females. Berried females were found in the catches during the first half of the year.

Portunus pelagicus

Estimated catch of the species was 35.4 tonnes at Yetimoga (Kakinada). Females of 145-156 mm carapace width and males of 150-175 mm carapace width supported the fishery. Berried females were observed throughout the year indicating continuous breeding. At Mandapam the gill nets and the mechanised trawlers together landed 111 tonnes of this species. Smaller size groups (110-139 mm) dominated the gill net catches while larger individuals (135-156 mm) were found in the mechanised trawl net landings. At Cochin, the estimated catch of the species from one observation centre was 3.8 tonnes during the period January-June. Crabs belonging to 41-50 mm group dominated in the beginning of the fishery while at the end of the season, 101-110 mm size group were more. Berried females were seen during the first quarter of the year.

Personnel:

K.H. Mohammed, FS; G. Sudhakara Rao, SRA; K.M.S. Ameer Hamsa, SRA; M. Kethirvel, RA.

Studies on the resources of commercially important molluscs (FB/MISC/2)

1. Ecology and biology of chank and pearl oyster at Tuticorin.

Seven trips were made for underwater observations using SCUBA equipment. The offshore rocky formation in zone 2 was studied, since a good oyster population was noticed there in October last. The population of oysters present in Tholayiram paar area appeared to range from 3 to 3½ years of age. But the density was poor being 50 Nos. per 100 sq. metres. Southern Tholayiram paar area contained younger oysters but denser population of per sq. meter. The survey conducted off Palipundu Paar an area on the southern range of the offshore rocky formation revealed oyster population of 3 year olds averaging 10 nos./sq. meter. From the above areas, 1000 oysters were collected and supplied for pearl culture experiments at Veppalodai.

Cephalopod investigations

For the study conducted at Madras, material was collected from the commercial landings at Royapuram, Kasimedu, Triplicane and survey zone T.N.5. The following were the important species in the catches: 1. Sepia pharaonis, 2. S. aculeata, 3. S. winckworthy, 4. Sepiella inermis, 5. Loligo duvaucelli, 6. Loligo sp., 7. Loliolus investigatoris, 8. Octopus dollfusi, 9. Octopus sp. and 10. Cistopus indicus. About 190 tonnes of cephalopods were landed at Royapuram of which 73% were landed during the second half of the year and the rest during the first half. July-September was the period of peak catches and catch rates, when about 50% of the annual catch was landed. Biological studies were undertaken on Sepiella inermis. The size range of this species was 25 to 75 mm in dorsal mantle length. The males appeared to become mature at a size of 40 mm and females at the size of 60 mm.

At Mandapam the catch of cephalopods in the trawl was about 6.2 tonnes this year. The highest monthly catches and catch rates were obtained in February, June, July and September. The cuttle fish, Sepia aculeata, was the dominant species in the trawl catches. Other important species were Sepia pharaonis, Sepiella inermis, Loligo duvaucelli and Sepioteuthis arctipinnis. The size range of Sepia aculeata in the trawl catches was 35-200 mm. Sexually ripe and partly spawned individuals of this species were recorded in January-August. Fish form the main diet of the species.

At Keelakarai (near Mandapam) about 7.9 tonnes of the squid, Sepioteuthis arctipinnis were landed in shore seines and hand lines, the peak season being March-June. At a fishing village near the Regional Centre of the CMFRI about 0.8 tonnes of cephalopods, of which S. arctipinnis was the dominant species were caught by shore seines, during January to April.

Mussels

The annual catch of mussels at Vizhinjam was about 53 tonnes from a bed area of 20 hectares and the annual average catch per fishermen per day was estimated as 29 kg. The mussels of size below 60 mm contributed

to about 90% of the total landings. All the maturity stages were observed throughout the year indicating continuous spawning with peak during June-July.

Personnel:

K. Nagappan Nayar, JFS; S. Mahadevan, JFS; K. Satyanarayana Rao, AFS; G.P. Kumareswamy Achari, SRA; R. Sarvesan, RA; K. Ramadas, RA; Pon Siraimetan, RA.

Mariculture, its potential and practical application (FB/MISC/5)

Fish and prawn culture in Salt pans of Tuticorin.

Excavation work and construction of bunds for 4 marine fish culture ponds at Veppalodai, each 23x15 m area and 0.6 to 1 m in depth was completed at the beginning of the year. Wooden sluices were fitted into the bunds. Surface water temperature of the ponds varied between 24 and 31°C, salinity between 34 and 37‰ and dissolved oxygen between 3 and 5 ml/L; pH remained more or less steady at 8 plankton volume was usually poor, and it was dominated by zooplankters. Two ponds were stocked with the young ones of the prawn Penaeus indicus during February and March, one with 10,000 and the other with 5,000 numbers. The other two ponds were stocked with the young ones of Chanos chanos during March-June, each with 2500 numbers. Soon after stocking heavy predation by crabs and snakes was observed which resulted in near total destruction of the stock of prawns and considerable depletion in the stock of Chanos. The growth of the stocked prawns was negligible, during the 2 months when sample could be obtained. About 10% of the Chanos population was tagged and the recoveries showed an increase in size of 5 mm in 20 days. However random samples of the population showed length increments of upto 20 mm in 2 months. The Chanos population appeared to be rather inactive and sluggish from the middle of the year. Artificial feeding with ground nut oil cake and by placing seaweeds in the ponds has shown encouraging results. Based on the valuable data collected during this year, the experiments are proposed to be re-designed in the next year in order to get more productive results.

Personnel:

S.Z. Qasim, Director; R.V. Nair, Deputy Director; P. Bensam, AFS; R. Marichamy, SRA.

Prawn culture at Cochin:

During the first quarter of the year experiments on the artificial prawn feeds were less efficient as growth protectors (growth rates 275 to 5 mm per month); the feed VII gave an average growth of 8.7 mm per month for a period of 3 months. It was found desirable to give the food in the form of pellets as the prawns were found to prefer larger particles. The pellets were prepared with different concentration of agar agar and were found to remain stable in the water for over 24 hours. Experiments with

feeds containing proteins derived from crustaceans (prawns) and fish (sardines) showed that the initial growth rate was better with food containing prawn meal (feed IX) but less than that obtained with sardine meal (feed X). The feed with prawn meal gave lesser average growth rate. During the second half of the year two more artificial feeds were compounded using fish meal as the main source of protein. The average growth rates for these feeds (No. XI and XII) were found to be 16.7 mm and 11.7 mm per month and 0.32 g and 0.19 g per month respectively. During the second quarter the attempts were made successfully to make the penaeid prawn Parapenaeopsis stylifera breed in the laboratory. The spawning took place at about mid-night and by the next morning the nauplius larvae emerged from the eggs. On the 12th day the larvae reached the mysis I stage. Pure cultures of the unicellular algae namely by Chlorella sp., Tetraselmis sp. and Synechocystis sp. were developed for trials as food for the larval stages.

Personnel:

S.Z. Qasim, Director; M.M. Thomas, AFS; K.V. George, RA;
M. Kathirvel, RA.

Mussel culture at Vizhinjam

The rope culture of ~~mx~~ mussels was intensified. It was observed that if the ~~fix~~ direct settlements of spats on the rope is not satisfactory seed mussels can be successfully transplanted on ropes/bamboo poles. Seed mussel transplanted in September would spawn during April and May (60% above 60 mm in size) and would be in partially spent condition in August (70% above 60 mm). Moreover if spawners are present in the vicinity of ropes with transplanted mussels, secondary settlement of spats occurs during the subsequent months. Barnacles, bryozoans, hydroids, tunicates and algae act as fouling agents but these are not detrimental to mussel farming at Vizhinjam. Adopting the techniques of transplantation, it has been estimated that the mussel can be harvested annually at a rate of at least 10 kg per meter of rope/bamboo, and the production can be at least 60 tonnes per hectare per year.

Mussel culture at Tuticorin:

Two consignment of mussels from Cape Comorin collected in September and November and 3 consignments from Colachel collected in September, October and November, were attached to different types of ropes (nylon, polypropylene, manila and coir). These were hung from a wooden raft 3.5 x 2.4 m and the raft floated near the south breakwater (Tuticorin harbour) and anchored at 10 m. depth. From September to November the mussels brought from Cape Comorin and Colachel showed a growth of 10 and 5 mm per month respectively. The increase in weight was also considerable. But after the heavy rains in October all the mussels in the farm ~~were~~ either migrated down from the rope, or perished due to reasons which are not clear. Therefore, fresh consignment brought in November from Cape Comorin and Colachel were put in plastic cages, and also attached to ropes, those on the ropes being further protected by a close meshed nylon net

ties loosely around. This method has proved successful, and the growth rate of mussels in the farm appears to be satisfactory. It is proposed in the coming months to watch for spat settlement in Cape Comorin and Colachel areas and transplant these at Tuticorin.

Mussel culture at Madras

A study was made of the suitability of the Ennore estuary (about 18 km north of Madras) for mariculture. The bar of the estuary is now-a-days kept open throughout the year and there is a fairly strong tidal current. The temperature of the water in the estuary varied from 25°C to 29.5°C. Temperature was high during February-April and low during November-December. Salinity was almost steady at about 33.0‰ from January-September. There was a decrease in salinity in October-November due to the north-east monsoon rains. The shallowness of the estuary and the strong tidal current ensures thorough mixing of the waters. Phytoplankton which forms the main food of the filter feeders like mussels were abundant in the estuary for most part of the year. A spurt in phytoplankton production was observed in March. These investigations showed that the Ennore estuary is a suitable site for culture of mussels and other molluscs. Experimental culture of the mussel was therefore initiated.

A survey for mussel was conducted in the Madras region. A natural bed of green mussel, Perna viridis, was found in the Madras Harbour-Kasimedu area and at Ennore. A wooden raft of 3.5 sq.m. was installed in the Ennore estuary in January. Mussels collected from the natural bed were tied to coir ropes with a mosquito netting cloth, and the ropes suspended from the frame. It was seen that the mussels attached firmly to the ropes within a period of two weeks. However, mortality of the transplanted mussel was high during March-April. Some of the transplanted mussel also tended to migrate downwards along the ropes.

Observations and experimental work on the biology of the mussel, relevant to mariculture, were also undertaken. The mussel attains sexual maturity at a length of about 55 mm. Actual spawning of mussel collected from the Kasimedu Bay in April was noticed in the laboratory at a temperature of 29°C. The number of eggs released per female of the length range 55 to 62 mm varied from 2 to 4 lakhs. Natural spawning took place in the estuarine waters in April and the spats were first observed on ropes, tiles etc. kept in the estuary by the middle of May 1973. The spats, 2-5 mm in length were found loosely adhering to the substrate. They settled throughout the length of the ropes, but high concentration was noted at the bottom of the ropes and on the tiles. The growth of these spats has been followed for about 7 months. From a size about 2 mm in June 1973 they have grown to 64 mm by the first week of January 1974, the average growth rates being 9 mm per month.

The following handicaps were encountered during the experiments.

- 1) The estuarine water swarm with the nauplii of cirripedes especially during May-July and these settle on the ropes and tiles kept in the estuary for culture of the mussel, sometimes interfering with the respiratory activities of the mussel. Moreover the Cirripede, Balanus being a filter feeder may turn out to be a serious competitor for the available food supply.

2) Due to the dredging operations near the mouth of the estuary the upper reaches of the estuary get silted fast. Therefore in addition to the hanging rope method, other methods of mussel culture may have to be adopted in the estuary.

Certain other interesting features have also been noted. Before these experiments were initiated, the gear mussel were not found in the Ennore estuary. The mussel which were transplanted to the estuary have acclimatised themselves well to the local environmental conditions. The presence of spats very near to the spot where they were transplanted show that they were growing and breeding in these waters. The growth of these beds is being watched, as these beds may turn out to be an additional source of income to the local fishermen.

Mussel culture at Kakinada

A bed of the green mussel, Perna viridis, was found in the Kakinada Bay. About 30 mussel of the size range 44-178 mm were kept in small iron cages of the size 12" x 9" x 5" with a plastic mesh and kept in the Bay. Observations on the growth of the mussels are being continued.

Personnel:

S.Z. Qasim, Director; K. Nagappan Nayar, JFS; S. Mahadevan, JFS; K. Rangarajan, AFS; Narasimham, AFS; G. Sudhakara Rao, SRA; G.P. Kumaraswami Achari, SRA; K.S. Sundaram, RA; K. Ramadas, RA; Miss. T.S. Naomi, RA

Edible oyster culture at Mandapam Camp

Spats of the edible oyster were collected in the Athankarai estuary near Mandapam Camp on oyster shell clutch tied to strong single bamboo strips and racks made of bamboo strips. There was good spat settlement on cultch tied to single bamboo strips and poor settlement on the cultches of racks. In addition a large number of cultch consisting of wooden blocks and oyster shell were kept tied to coir ropes suspended from horizontal poles in the estuary. The spat settlement was poor in January, but good in March. The height of spat varied between 7 to 33 mm in March with 2 modes at 16 mm and 22 mm. There was progressive growth of these spats. The maximum size recorded in November was 110 mm. The predators Thais rudolphi and hermit crabs, were found in small to moderate numbers over the young oysters, and these were removed. Cirripedes settled on the cultch throughout the year and were scraped.

The salinity of the estuary varied between 28‰ and 35.4‰ during January-September but fell to about 7‰ in October-November. The water temperature varied between 27.2°C and 30.7°C during the year.

Edible oyster culture at Tuticorin

An oyster farm was set up on the western shore of the Hare Island in May 1973. About 500 oysters ranging in size from 50-55 mm were collected and put in specially designed cages of nylon wire mesh, which were suspended at depths varying from 1 to 3 m. Over a period of 100 days the oyster increased 35 mm in length, but by this time the cages got damaged mainly due to inclement weather and therefore the farm was shifted to the eastern side of the Island. Fresh collections of oysters 55 mm in length were made and kept in the cages. However, growth in this locality does not appear to be very encouraging, since the oysters increased only by 15 mm in length over the period of 120 days. It is proposed to intensify the study during the year 1974. A consignment of oysters from Madras which were transplanted at Tuticorin survived the changed environmental conditions only for a period of 90 days. It has therefore been decided not to try transplantation of this stock from Madras for the time being.

Personnel:

S.Z. Qasim, Director; K. Nagappan Nayar, JFS; K. Satyanarayana Rao, AFS; K. Ramadas, RA.

Experiments of pearl culture

The project on "Experiments on pearl culture" made significant progress during the year 1973. The pearl culture farm and laboratory were established at Veppalodai during December 1972. The farm was strengthened during the first half of 1973 and about 2000 oysters were collected from the natural pearl banks off Tuticorin for cultivation in the farm.

The designs of rafts underwent improvements; the rafts have withstood both the south-west and north-east monsoons, including several spells of depression and squally weather in the area.

A major breakthrough was achieved in developing the technology of cultured pearl production. The conditioning techniques and surgical procedures employed in the operation of pearl oysters proved successful and quick improvements were effected in both. The first free, spherical cultured pearl of India was produced at Veppalodai in July 1973 and two other batches of operated oysters examined in October and November 1973 yielded quality cultured pearls, confirming the successful development of the technology. Though the duration of culture of the first three batches of oysters ranged from one to three months, the pearls produced were brilliantly lustrous. Silvery-white, ivory white, golden yellow and steel-grey pearls have been produced so far. These results hold out bright prospects for a pearl culture industry in India based entirely on indigenous technology.

Biological and environmental studies were carried out. Fouling by barnacles had the most harmful effect on the well-being of the oysters in the farm. This was reduced to some extent by increasing the frequency of shell-cleaning operations in the farm. Growth of oysters in the farm was quite distinct as revealed by the presence of growth processes on the shell margins.

Trichodesmium blooms were encountered in the farm during March and September, but had no visible effect on the oysters. Spats of pearl oysters have been collected in the farm, which augurs well for the further development of mother-oyster culture.

Notable progress has been made in the experimental production of spherical shell beads from the Indian conch, Xanopus pyrum, with the cooperation of the Central Institute of Fisheries Technology, Cochin. The shell beads compare favourably in many respects with those imported from Japan. These have been used as nuclei in the experiments with encouraging results.

Personnel:

Dr. S;Z. Qasim, Director; K. Alagarswamy, JFS; A. Chellam, JSA.

Research contemplated

As mariculture work has given promising results, an expanded programme in this field will be given the necessary support. The immediate aim will be to consolidate the gains so far made in the culture of the various animals and to improve the techniques for obtaining higher yields per hectare. The problems of transplantation and acclimatisation of seeds to new grounds will receive due attention. The work on the possibilities of culturing other high priced fishes, besides those being cultured at present will be explored. In the capture fisheries research, stock monitoring programme will receive greater attention than hitherto. It has to be mentioned here that this programme, which will be confined to the major fisheries, has to be repetitive from year to year so that the large scale changes that occur in the characteristics of the stocks may be investigated and the reasons thereof determined. Collaborative programmes with other organisations/Institutions in the field of exploratory survey will be continued.

MARINE BIOLOGY AND OCEANOGRAPHY

Summary of Salient findings

Hydrographic data were studied in the form of average conditions month-wise for each zonal belt in each latitude for different depths up to 300 m along the south west coast of India. Upwelling was found to be conspicuous in the region 11° to 13° N during the peak monsoon period. Sinking was observed in this area during December. Routine hydrographic observations were carried out at Karwar, Calicut, Cochin, Tuticorin and Madras.

A new theory has been developed regarding the frictional force communicated to the lower layers of the sea from the surface wind stress.

Temperature distribution studies indicate the presence of two thermal fronts located at 13° S and 24° S in the Indian Ocean where the South Equatorial Countercurrent and the Subtropical countercurrent are observed on the current structure. These have not been reported earlier. Another feature resulting from this study is that the North Equatorial Current has been found to exist even up to the end of June.

The current structure has been found to play a major role in modifying water characteristics. In the region of easterly flow, the water is characterised by high salinity, low oxity and more nutrient concentration, whereas in the zones of westerly flow the water is of less nutrient concentration, low salinity and more oxity perhaps due to the mixing of two different types of waters in the eastern and western Indian Ocean. It was also observed that the zonal component of the current vector, in the Arabian Sea is influenced by the islands.

The rate of production, along the outer edge of the continental shelf up to 19° N on the west coast of India was low. ($10-60$ mg C/m²/day). However, in the mud bank area south of Alleppey the rate was high ($100-800$ mg C/m²/day).

Diurnal variations of dissolved Carbohydrates (DCHO) were measured in Cochin backwater and in cultures of three species of algae, and the rate of its release was found to be variable.

Zooplankton production at Calicut inshore waters during this year compared favourably with the previous years. Two major peaks were observed during pre-monsoon and post-monsoon months. Analyses of R. V. VARUNA Zooplankton collections to study the distribution patterns of the adults and larvae of different groups of zooplankton were made at Cochin. As a result, the status and validity of Doliopsis rubescence has been evaluated; Doliopsis spp. were more confined to Laccadive Sea. Distribution patterns of 11 dominant species of calanoid copepods in relation to hydrography were studied. Surface currents and species distribution were found to be interrelated. Copepod indicator species were selected and their spatial and temporal distribution was investigated in eritic and oceanic areas. The larval development of 3 emphausiid species has

been studied and the developmental stages described. The distribution patterns of Sagitta decipiens were studied and attention drawn to its importance as an indicator species. The onshore and offshore movements of 4 species of Chaetognaths were traced and variations in day:night distribution of different species of Chaetognaths were investigated. The diel distribution of zooplankters in Cochin Backwater in relation to tide has been investigated.

Zooplankton biomass was high in the inshore waters of Madras during November-December period. Penaeid eggs were recorded during December.

Studies on fish eggs and larvae have been initiated at Tuticorin. At Madras mackerel larvae has been identified and described. An account of the description of mackerel larvae from the south west coast and their occurrence based on R.V. VARUNA collection has been completed.

Trichiurus auriga, a deepwater ribbon fish is recorded for the first time from Indian Seas and aspects of its biology based on material collected from the upper continental slope along the south west coast has been studied. Studies were made on the hitherto unreported skin and bone tumours of Tachysurus jella and a detailed report has been prepared.

Caloric values of M. dobsoni calculated from organic carbon and the conversion factor for this species worked out. In addition, the energy conversion efficiency of Macrobrachium idella was studied.

Fish mortality of considerable magnitude due to water pollution was observed in the Cochin Backwater in locations adjacent to Ambalamughal and Alwaye. Primary production in the pollution hit industrial areas around Alwaye was found to be low. Results of experiments conducted on phytoplankton toxicity using aqueous extracts of Iranian Crude oil showed that photosynthesis is depressed in high oil concentrations.

A survey of the major resources of the reefs on the south east coast of India has been carried out, and the quarrying of corals was observed to have deleterious effects to the reefs. Recolonisation of corals on Palk Bay side was observed.

Observations were made on the growth rate of Chelone mydas kept under laboratory conditions. Four species of turtles Chelone mydas, Eretmochelys imbricata, Dermochelys coriacea and Lepidochelys olivacea were exploited by bottom set gill nets along the south-east coast of India, and data on the catch have been collected (230/yr).

RESEARCHES IN HAND

Environmental studies - Physical and Chemical aspects (MBO/ES/1)

Hydrographic data collected from the west coast of India from Cape Comorin to Karwar in a quasi-meridional section for the ten year period 1957-67 were studied in the form of average conditions month-wise and latitude-wise for the different standard depths upto 300 m, and monthly distribution charts of salinity, temperature and dissolved oxygen were prepared. During the peak monsoon period (July-August) upwelling was found to be predominant between 11°N to 13°N along the south west coast of India. Upward lifting of the thermocline and the oxygen discontinuity layer were conspicuous in this region 11°N to 13°N during the period November, December and January. Southward sinking of the surface waters meridionally in the region between 11° and 14°N was noticed during November, December and January. This sinking subsides in February.

Observations on basic hydrological and meteorological conditions at different centres

Routine hydrological and meteorological data from the inshore waters were collected regularly at Karwar, Mangalore, Calicut, Cochin, Madras and Waltair.

Karwar

A total of 342 sea water samples were analysed during the year from Karwar Bay and Devagad Island. During post-monsoon period, the deviations observed in each parameter from surface to sub-surface waters were prominent. Temperature, oxygen, nitrite and pH values were high at the surface than at the bottom, whereas salinity, inorganic phosphate and silicate showed an increasing trend with depth.

Mangalore

Sea water samples were collected from 6 and 12 meter stations off Ullal during January to May and from August to December. Surface temperature increased steadily during January to May from 26.9°C to 31.3°C. Salinity also recorded varying values, fluctuating within the range of 26.83‰ (October) to 35.69‰ (April). The range of dissolved oxygen and pH were 1.54 to 4.51 ml/l and 7.3 to 8.4 respectively. The inorganic phosphate and silicate values were low during the January-May period (0.05-0.07 µg at/l for phosphate and 3.75-850 µg at/l for silicate respectively).

Kozhikode

Weekly collections of water samples were carried out from three stations throughout the year, except during the monsoon months of July and August. The surface temperature showed an increase from the deeper station to shallow station. pH was found to be decreasing from surface

bottom and from deeper station to shallow station. Salinity values were generally high during March to May and a clear decreasing trend was noticed from September to December. The oxygen values at all the three stations were found to be fluctuative. The lowest value (2.35 ml/l) was recorded from bottom at the 5 m station and the highest value (5.5 ml/l) was recorded at surface at the 10 m station. The reactive phosphorus values were found to increase at lower depths. Total phosphate at 20 m station fluctuated between 1.66 ug at/l at surface in April and 9.96 ug at/l at bottom in September. The reactive silicate recorded varying values and it was low at surface in November and high in April (5.95 - 16.70 ug at/l and 7.14 - 21.88 ug at/l respectively for 20 m and 5 m stations).

Cochin

Monthly collections of water samples were carried out from six stations between Cochin Backwater and the industrial area of Alwaye from the Periyar River and the seasonal fluctuations in temperature, salinity and dissolved oxygen were recorded. Inorganic phosphate values at stations near the Industrial area showed a very high trend (35.28 ug at/l) during March. The pH value showed significant change from 4.8 in January to 8.7 in October at the stations near the industrial belt.

Tuticorin

Hydrographical observations carried out at Veppalodai fish farm (Tuticorin) from April onwards showed the following trends: Surface temperature varied between 29.7 to 26.6°C from April to November. Except in November, salinity varied between 37.89 - 33.56‰ and in November salinity recorded much lower values (minimum 22.49‰). Dissolved oxygen ranged from 6.1 ml/l to 3.0 ml/l and the range of pH values was 7.9 to 8.6.

Madras

Water samples collected from the fishing grounds off Madras were analysed. Salinity values showed an increasing trend from January to March (34.21‰) they remained steady from April to September with a gradual decline therefrom and minimum values were recorded during November (23.16‰). Dissolved oxygen content varied from 3.76-5.60 ml/l. Inorganic phosphate showed a steady decline from January (0.88 to 2.49 ug at/l). The phosphate values were high during July to September and the values were low during October to December. Nitrite values were low from January to March. An increase was observed in April and this trend persisted during the rest of the period. Silicate values, although were low during January to March, showed an increase during April and from June to December recorded high values (7.00 - 19.92 ug at/l). Nitrate values were low from January to June and were high during the rest of the months (0.80 - 2.52 ug at/l). pH values remained steady around 8.5 throughout.

Waltair

Collections were made only during the second half of the year. The results of the observations are summarised in the table below:

Months 1973	Temperature		Salinity ‰	Oxygen ml/l	Nutrients $\mu\text{g at/l}$	
	Air	Sea			Phosphate	Silicate
July	30.6	28.9	32.86	4.7	1.2	20.0
August	29.3	29.6	28.97	5.6	0.3	15.0
September	31.5	30.1	30.28	4.3	0.8	12.5
October	31.3	30.4	19.50	5.9	0.4	18.8
November	26.2	27.0	21.18	6.2	0.8	17.5
December	26.4	25.8	28.60	5.5	1.2	28.8

Researches contemplated

Collection and analysis of the routine hydrographic data will be extended to additional centres along the Indian coasts in order to obtain a comprehensive region-wise picture of the variations in the hydrographic properties. Two 43½' boats one each at Cochin and Mandapam Camp will be employed for collection of regular data. Further collections will also be made by participating in the fishingtrips of DFS vessels from different centres. Environmental data will be collected from the northern parts of the Vembanad Lake and adjacent backwaters during the course of 1974.

Personnel:

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Circulation and related phenomena (MBO/ES/2)Researches in hand

A theory has been developed regarding the frictional force communicated to the lower layer of the sea from surface wind-stress.

To illustrate the water characteristic, profiles of temperature, salinity, oxity, phosphate phosphorous and thermosteric anomaly have been drawn for a meridional section along 65°E from 19°N to 41°S during the period May 17 to July 4, 1964. Temperature distribution indicates

the presence of the thermal fronts located at 13°S and 24°S where the South Equatorial Countercurrent and the sub-tropical countercurrent respectively are observed on the current structure. So far no information was available about their presence in the Indian Ocean. This study has indicated their presence on the current structure as well as on the distribution of properties. Another conspicuous feature resulting from this study is that the North Equatorial Current which was understood to have been replaced by the Southwest Monsoon Current with the onset of monsoon, has been found to exist even up to the end of June.

The distribution of salinity, oxity and phesphate-phosphorous indicates northward flow of the subtropical water up to 13°S and the southward movement of the Arabian Sea water up to 5° N in the upper 500 m. The Equatorial Indian Ocean water is of homogeneous nature in respect of the salinity, oxity and phesphate-phosphorous concentration. The current structure seems to play a major role in modifying water characteristics. In the region of easterly flow, the water is of less nutrient concentration, low salinity and more oxity, perhaps because of mixing of the two different types of waters existing in the eastern and western parts of the Indian Ocean.

It was also observed that the zonal component of the current vector, in the Arabian Sea, is influenced by the islands. On this section at the latitudes where the islands are situated, the zonal component is, in general, weakened and at times even the sign changes.

Personnel:

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Phytoplankton Productivity (MBO/ES/3)

Researches in hand

Cochin

Primary productivity along the Indian coasts

Measurements of primary production were made along the outer edge of the continental shelf upto 19° N along with try net collection during ~~three~~ three cruises of R.V. VARUNA. The rate of production per unit volume was low (10-60 mg/m³/day). In most of the stations high bacterial production was observed as indicated by C¹⁴ uptake in the dark bottles.

Investigations carried out to assess the role of nanoplankton in the total organic ~~production~~ showed that on the average 70-85% of the total production in the sea and backwaters is contributed by nanoplankters. The rate of production in the mud bank area at Ambalapuzha was found to be of a high order (100-800 mg/m³/day).

Standing Crop of Phytoplankton

A bloom of the diatom Skeletonema costatum (average more than 4 lakh cells/l) was observed in Cochin backwater during January. However, in March the diatom Chaetoceros spp. and the dinoflagellate Gerrathium furca formed the major components of phytoplankton. Statistical analysis of the data on standing crop was also carried to interpret the seasonal and spatial variations and also the influence of environmental parameters.

Culturing phytoplankton organisms

Diurnal variations of dissolved carbohydrates (DCHO) were measured in the Cochin Backwater and in cultures of three species of algae. The carbon released in DCHO was about 40% of the total assimilation with maximum values during the late afternoon and minimum in early morning hours. The rate of release of DCHO in cultures varied from species to species at various stages in their growth curve.

Calicut

Studies were carried out on phytoplankton productivity by collecting weekly samples. The standing crop of phytoplankton, excluding the monsoon period was maximum in March and was of lesser magnitude compared to the previous year.

Minicoy

Primary production measurements using C^{14} were carried out in Minicoy lagoon and adjoining sea. The lagoon generally showed a higher rate of production than the open sea.

Researches contemplated

Phytoplankton samples already collected by the Institute from the Indian coasts will be processed and analysed for estimating the standing crop and quantitative distribution of component species. Productivity studies will be taken up at additional centres along the Indian coasts and at Minicoy.

Personnel:

P.V. Ramachandran Nair, JFS; K. Radhakrishna, AFS; V.S.K. Chennubhotla, AFS; Sumitra Vijayaraghavan, AFS; K.G. Girijavallathan, SRA; C.P. Gopinathan, SRA; K.J. Joseph, RA.

Studies on Secondary Production and related aspects (MBO/PL/1)

Researches in hand:

Calicut

Zooplankton samples collected during the period January-May and September-December, were analysed. The estimated range and mean values of zooplankton showed the following trends:

	<u>Range</u>	<u>Mean</u>
Volume (ml)	1.8 - 67.0	23.2
Dry weight (ml)	400 - 11,000	2620

It was observed that zooplankton production during the year compared favourably with the previous years. Two peaks were recorded for the zooplankton, one major peak during the pre-monsoon period and another lesser one during the post-monsoon months.

Qualitative analysis of the samples revealed that copepods formed the most important and major item followed by cladocerans, although other constituents such as coelenterates, lucifers, appendicularians, chaetognaths and pteropods were also represented in varying quantities. Copepods were mainly constituted by Temora turbinata ~~and~~ Acrocalanus, Centropages eucalanus, Canthocalanus and Oithona. Other groups represented in the plankton were Undinula sp., Acartia spp., Labidocera sp. and Euchaeta sp. In general, copepods were most abundant during the post-monsoon period (October-November). Cladocerans were constituted by Penilla avirostris which was abundant in October. Evadne tergestina was recorded in lesser numbers.

Cochin

Seasonal occurrence and distribution of pelagic tunicates of the Laccadive sea were studied. Salpidae was represented by Thalia democratica and Cyclosalpa pinnata var. sewelli and Doliolidae by Doliolum sp., D. denticulatum var. ehrenbergi and "Nurse forms". The status and validity of the species Doliopsis rubescence have been evaluated. Analyses of the zooplankton samples from the coastal waters and the Laccadive Sea indicate that Doliopsis spp. generally occur in oceanic waters. Gut content analysis of Cyclosalpa pinnata var. sewelli revealed that the food consists mainly of microfauna such as shelled protozoans and microflora such as diatoms and dinoflagellates.

Distribution charts of copepods in the coastal, neritic and oceanic waters along the west coast of India and Laccadive Sea (09°40' - 11° 50' N and 71° 00' - 76° 10' E) have been prepared and the seasonal variation in abundance of 11 dominant species studied. Based on their distribution patterns "indicator species" were selected and their spatial and temporal distribution studied. Depth-wise distribution of temperature and salinity has been plotted and the topography of the thermocline investigated. It was found that during Southwest monsoon, thermocline

slopes up towards the coast and in pre-monsoon period it slopes down offshore. Its depth was maximum during the post-monsoon period. Surface currents and species distribution were found to be inter-related.

Diel periodicity of zooplankters in relation to tidal cycle in Cochin Backwater has been studied and the results indicate that tides exert profound influence on the distribution of zooplankters in this tropical estuary.

Studies on the larval development of euphausiids from the plankton have been carried out. The post-naupliar developmental stages of Euphausia diomedia and E. distinguenda have been described. Larval stages of Stylocheiron affinis have been identified and detailed studies were made and the stages described.

Investigations on the chaetognaths of the west coast of India and Laccadive Sea showed that the following 14 species belonging to three genera Sagitta, Pterosagitta and Krohnitta are represented in the Collections. S. inflata (44.5%), S. bedoti (17%), S. decipiens (9%), S. pacifica (9%), P. draco (7.5%), S. hispida (4%), S. regularis (2.4%), S. ferox (2.1%), K. pacifica (1.6%), S. robusta (1.5%), S. pulchra (0.7%), S. hexaptera (0.3%), K. subtilis (0.3%) and S. lyra (0.1%). (Number in paranthesis indicates the percentage of occurrence of each species in the collection). The most interesting feature brought to light through this study was the identification of the mesopelagic species Sagitta decipiens as an indicator species. The onshore and offshore movements of S. pacifica, S. hispida, S. regularis and P. draco were traced during different periods of the year. Variations in Day:Night distribution of different species were also investigated. Species such as S. inflata and S. bedoti evinced little differences in day:night distribution, whereas species such as S. decipiens, S. pulchra, S. hispida and P. draco showed distinct differences in distribution during day and night.

Apart from the quantitative studies on the distribution of siphonophores along the west coast of India and Laccadive Sea, 85 samples collected from Cochin backwaters, were analysed and the distribution of siphonophores investigated.

Tuticorin

Investigations on the zooplankton from inshore and offshore waters of Tuticorin have been initiated. Maximum values of the standing crop of zooplankton were recorded from inshore waters during August-September period and minimum during November-December the standing crop of zooplankters also showed the same trend (August-September period 23.75 ml) and November-December minimum 0.5 ml) in the offshore water also.

Investigations on the zooplankton collected from the main feed-ing canal of Veppalodai salt pan reservoirs showed that the standing crop varied from 1-123 ml/5 min. haul. The monthly average volume was recorded as 35 ml. Typical coastal zooplankton groups were the major component of collections. The salient features of the analyses are: The abundance of zoea larva during April and July, and Acetes indicus during May, September and October and the poor standing crop of zooplankton during November-December, due mainly to rains and influx of freshwater.

Madras

Analyses of the zooplankton collected from the inshore waters of Madras coast revealed that the zooplankton biomass was high during November-December and low during January-March.

Researches contemplated

Investigations related to secondary production will be continued in 1974. A new project on the mass culturing of plankters will be taken up with a view to develop mass cultures of various organisms at different trophic levels; to study their growth rate and conversion efficiency; and for determining their utility as feed for the rearing of cultivable food fishes, crustaceans and molluscs.

Zooplankton investigations will be extended to other centres along our coast during 1974 with the availability of our own boats and those of sister organisations.

Personnel:

E.G. Silas, SFS; K.G. Girijavallabhan, SRA; P. Dhandapani, SRA; P. Parameswaran Pillai, SRA; K.J. Mathew, SRA; M. Srinivasan, RA; M.M. Meiyappan, RA; K. Rengarajan, RA.

Studies on fish eggs and larvae from the plankton (MBO/PL/2)Researches in handCochin

Fish eggs and larvae were sorted out from zooplankton samples collected from Cochin Backwater and their qualitative and quantitative distribution studied. A paper on the occurrence and abundance of the larvae of the Indian mackerel, Rastrelliger kanagurta along the west coast of India based on collections made during R.V. VARUNA cruises have been completed.

Tuticorin

Fish eggs and larvae were sorted from the zooplankton samples collected from Tuticorin Bay, and their seasonal distribution was studied. During February, a maximum number of 3,368 fish eggs and 10,316 fish larvae were recorded from the plankton samples collected during the haul of 10 minutes duration.

Madras

Fish eggs and larvae collected were sorted out and identified after rearing them in laboratory condition. Three major types were identified and these types of eggs were provisionally assigned to those of Anchoviella spp., Cynoglossus spp. and Saurida spp. First type of eggs was abundant in the samples during January and second and their types during May respectively. An egg mass of Cypselurus sp. was collected from the inshore waters during January, which did not survive for more than six hours. A mackerel larvae measuring 2.98 mm in total length occurred in the plankton samples, collected on 22-3-1973, and detailed description of the larvae is being published.

Researches contemplated

Collection of fish eggs and larvae and rearing experiments in order to investigate growth, survival and other aspects of life history studied. Planned surveys of fish eggs and larvae to be carried out at selected centres of east and west coasts in order to understand spawning seasons, spawning grounds and recruitment studies.

Personnel:

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Survey and Culture of economically important sea weeds(MBO/MISC/1)Researches in handSurvey of marine algal resources

Sea weed surveys were carried out from the second and third sections covering 41 stations along the shore line and 7 stations around islands on the south east coast of India. Environmental data pertaining to temperature, pH, oxygen, salinity, silicate, phosphate, nitrate and nitrite has also been collected along with the observations. Total biomass of seaweeds estimated during the surveys is as follows:

Depth range (m)	Area surveyed (in sq. m.)		Mean density	Estimated production (in tonnes)
0-4	Gulf of Mannar (coastline):	I survey	154.1	1638.42
	19443000	II survey	185.3	1429.41
0-4	Gulf of Mannar (islands):	I survey	135.5	7701.41
	98825925	II survey	133.8	6467.80
0-4	Palk Bay region:	I survey	106.1	2110.51
	28600754	II survey	124.8	2355.26

Field investigation of economically important sea weeds

Field cultivation of common agarophyte Gracilaria edulis has been experimented in the Gulf of Mannar, Palk Bay and Athankarai estuary. In the gulf of Mannar, five coir meshed wooden frames, 4 x 2 m size were used for the experiment. These frames were fixed at about a depth of one foot from the sea bottom and the remaining two were tied loosely to float on the surface. During the first 60 days the growth was at a high rate (6.5 cm/15 days) and afterwards the growth rate became low (3-4 cm/15 days). The plants reached almost its full growth by the 80th day when the harvest was made. Field cultivation of Gelidium acerosa was initiated in the Gulf of Mannar area.

On the Palk Bay side, two culture frames of 2 X 2 m. size were used for the experiment. The experiment was started in August, 1973 and the growth was found to be high and luxuriant during the first 15 days. In the Athankarai estuary, three coir meshed wooden frames of 1 x 1 size were used for the experiments, at the bar mouth and in the upper reaches of the estuary. At the bar mouth, the rate of growth of the sea weeds were high (6 cm /15 days) and it lessened after the 30th day, when thick sediment coating was observed on the growing weeds. Near the head of the estuary, their growth rate was very low and subsequently all plants died due to the dilution of the surrounding water during rains.

Researches contemplated

1. Survey of sea weed resources in collaboration with State Fisheries Departments and Central Salt and Marine Chemicals Research Institute 2. Culture of seaweeds both in laboratory and in the field for studying life history and physiological factors and 3. Developing suitable techniques for sea weed farming.

Personnel:

P.S. Kuriakose, RA; N. Kaliaperumal, RA; S. Kalimuthu, JSA.

Investigations on deep water fishes: (MBO/MISC/2)

Researches in hand:

Detailed investigations on the biology of the deep water fish Chascanopsætta lugubris has been carried out. The gut contents of different specimens were analysed for understanding the feeding nature of these fishes. Studies were also carried out on the meristic and morphometric characters and fecundity of Epinnuba sp. Detailed investigations on the biology of the deep water ribbon fish Trichiurus auriga were under progress. The specimens examined were of the size range 179-347 mm. The studies of this species include determination of its specific status, variability of morphometric and meristic characters, biology of reproduction and maturity.

Studies on the hitherto unreported skin and bone tumours of the marine cat fish Tachysurus jella, collected from different regions of the west coast of India were carried out. The biochemical composition of the muscle and tumour tissues have been analysed in this study.

Researches contemplated

Data collected on the biology of deep water fishes obtained during exploratory cruises of R.V. VARUNA from the west coast will be analysed and detailed reports on the biology of different species prepared for publication.

Personnel:

E.G. Silas, SPS; M.S. Rajagopalan, AFS; V. Kunjukrishna Pillai, SRA; G.S. Daniel Selvaraj, RA; A. Regubathan, RA; M. Rajagopalan, RA; I. David Raj, RA; N. Nandakumar, JSA and others.

Mud bank investigations (MBO/MISC/3)

Researches in hand

Hydrographic data have been collected in the mud bank regions at Ambalapuzha and Nattika, and also from the outskirts of mud bank area at Ambalapuzha during the cruises of R.V. VARUNA. During the mud bank season, the ~~max~~ observations at Ambalapuzha mud bank showed variations of dissolved oxygen from 3.6 to 2.0 ml/l salinity from 33.67 to 35.07% ~~mg~~ inorganic phosphate from 1.10 to 3.72 ug at/l, nitrate from 0.08 to 0.38 ug at/l and silicate from 22.4 to 27.7 ug at/l. Diatomaceae were found less in number and dinoflagellate, Noctiluca miliaris was noticed to be present in maximum abundance, although the latter was not observed in red thick patches. Copepodites and copepods were found dominant, while the other zooplankters were rather rare or absent. Total organic carbon values ranged from about 1 micron or even less, to 1350 microns. The total organic carbon varied from 21 to 19.8 mg/C/g dry weight. The gut contents of prawns and fishes collected from this area contained particles ranging in size from less than 1 micron to 20 microns. Metapenaeus dobsoni, Sardinella longiceps and Leiornathus species were the major component of the fisheries. Young ones of mackerel and sardine constituted a sizeable portion of the catch towards the close of the mud bank season. The mud banks at Nattika and Tanur were not well formed.

Researches contemplated

Studies on mud banks will be continued during 1974. Investigations will be extended to northern parts of Kerala Coast also, especially at Nattika.

Personnel:

A.V.S. Murty, FS; D. Sadananda Rao, AFS; C.K. Gopinathan, SRA; C.P. Gopinathan, SRA; K.J. Mathew, SRA; A. Regunathan, RA; P.G. Jacob, RA.

Energy flow in some selected ecosystems (MBO/MISC/5)Researches in handOrganic carbon

The organic carbon of prawn species and their stomach contents were analysed. The ratio of body carbon to food carbon in a zooplankton feeder and a carnivore were nearer to 1.0; in phytoplankton and detritus feeder these ratios were between 5 to 7. In addition, the food carbon and caloric values of the fishes such as Sardinella longiceps, Etroplus suratensis, Thryssa sp., Nemipterus japonicus and prawns such as M. dobsoni and M. monoceros were worked out using different methods. Caloric values of M. dobsoni calculated from organic carbon showed that the conversion factor for this species is 1 mg carbon = 14.57 calories.

Metabolic activity

Experiments conducted to determine the rate of oxygen consumption of Muril macrolepis in relation to different salinities based on material collected from Korapuzha estuary near Calicut revealed that the rate of oxygen consumption is higher at low salinities.

Energy conversion efficiency:

Changes in the biochemical composition, caloric content and energy utilisation during the embryonic stages of Macrobrachium idella were studied, and the results showed that protein contributed 67.4% of the total energy available for development. The gross efficiency and energy loss worked out to be 44% and 56% respectively. Feeding experiments on Metapenaeus monoceros showed an assimilation efficiency of 97-89%. The gross efficiency ranged from 11% to 35% and net efficiency worked out to be 12%-36%. Weight increment in Ambasis gymnocephalus studied by feeding it with minced meat of prawn, Metapenaeus dobsoni showed an overall weight increase of about 15-20%.

Researches contemplated

Investigations will be carried out on different fishes, crustaceans and molluscs in order to assess their energy conversion efficiency.

Personnel:

S.Z. Qasim, Director; P.V. Ramachandran Nair, JFS; Sumitra Vijayaraghavan, AFS; D.G.V. Easterson, RA; G.K. Vinci, RA; P.G. Jacob, RA; C.V. Mathew, RA.

Marine Environmental damage (Pollution) (MBO/MISC/6)

Researches in hand

Studies on the primary production in the pollution hit industrial areas around Alwaye in the Periyar River showed that the production was comparatively low throughout all months. The lowest values obtained in two stations in this area, were 0.4 and 0.34 mg C/m³/hr respectively. Besides, high uptake of C¹⁴ was observed in this area indicating high bacterial pollution. Experiments relating to phytoplankton toxicity using aqueous extracts of Iranian Crude oil in different concentrations were conducted. The results indicate a depression of photosynthetic activity in higher concentration of oil and vice versa.

The effect of effluents from Industries on the fishery has been studied in Cochin backwaters. The cause for large scale fish mortality near Ambalamughal during June was identified to be due to water pollution by ammonia from the urea plant of FACT. The pH value in the polluted water was 8.3-8.8. At Madras, a survey of the industrial effluents were carried out for the assessment of the sources of pollution.

Researches contemplated

Laboratory studies will be conducted to investigate the deleterious effects of pollutants, especially oil and effluents from Industrial plants, on the fauna and flora of Indian coasts.

Personnel:

S.Z. Qasim, Director; E.G. Silas, SFS; P.V. Ramachandran Nair, JFS; M.S. Rajagopalan, AFS; C.K. Gopinathan, SRA; V. Chandrika, RA; G. Thankappan Pillai, LFA.

Investigations on Coral reefs and Turtles (MBO/MISC/8)

Researches in hand

A survey of the major resources of the fringing reefs of Palk Bay and Gulf of Mannar around Mandapam was carried out. Molluscan fauna of reefs was investigated qualitatively and quantitatively. The survey revealed that the quarrying of corals have deleterious effects to the reefs and it considerably depletes the reef-dwelling and reef-building faunas. Slight signs of recolonisation on Palk Bay side were observed. Fishes such as Siganus java, Calliodon gibbosa, Upeneus vittatus and Lethrinus frenatus supported the fishery, which has been estimated to be of the magnitude of about 1500 mg/month.

Young ones of turtles, hatched under laboratory conditions were studied and informations on their growth rate collected. An young one of Chelone mydas increased by 2.45 kg in weight and 3.1 cm in length in one year: Chelone mydas, Dermochelys coriacea, Eretmochelys imbricata and Lepidochelys olivacea are the three species exploited by bottom set gill nets in the Gulf of Mannar. Investigations were carried out at Tuticorin where turtles are gathered from Kilakkarai and Pamban; number of turtles that were marketed at Tuticorin for consumers during the year 1972 is as follows: January (60), February (60), March (18), April (48), May (40), June (30), July (48), August (48), September (16), October (18), November (30), December (12). Of the total catches, Chelonia mydas formed about 90% and Lepidochelys olivacea the rest during 1973. Observations carried out on the turtle fishery at Kuttankuli showed that about 80 turtles were caught in a single operation of the bottom set gill net. However, turtle fishery has been abandoned in remote villages mainly due to the lack of transport facilities. Information collected so far indicate that the area between Cape Comorin and Periyathali in the Gulf of Mannar forms a fertile ground for turtles.

Researches contemplated

Resources surveys will be conducted at Palk Bay and Gulf of Mannar and at Laccadive Archipelagoes to assess the deleterious effects of quarrying of coral blocks from reefs. Studies also will be conducted on the floral and faunal composition of coral reef community.

Personnel:

C.S. Gopinadha Pillai, AFS; A.A.P. Mudaliar, JSA; Bastian Fernando, JSA.

STAFF POSITION AS ON 31-12-1973

(Names of Officers equal to gazetted status)

Director: Dr. S.Z. Qasim
 Deputy Director: Dr. R.V. Nair

I. FISHERY SURVEY AND STATISTICS DIVISION

1. Shri V. Sadasivan, FS
2. Shri M.G. Dayanandan, AFS
3. Shri S.K. Dharmaraja, AFS

II. FISHERY BIOLOGY DIVISION

1. Dr. K.V. Sekharan, SFS
2. Shri K.H. Mohamed, FS
3. Dr. C. Seshappa, FS
4. Shri T. Tholasilingam, FS
5. Dr. S.V. Bapat, JFS
6. Shri G. Venkataraman, JFS
7. Shri K. Nagappan Nayar, JFS
8. Dr. B.Krishnamoorthi, JFS
9. Dr. B.T. Antony Raja, JFS
10. Dr. M. Vasudev Pai, JFS
11. Dr. K. Alagarwami, JFS
12. Dr. V. Balakrishnan, JFS
13. Shri V. Balan, JFS
14. Dr. S. Ramamurthy, JFS
15. Dr. M.D.K. Kuthalingam, JFS
16. Dr. P. Vijayaraghavan, JFS
17. Shri S. Mahadevan, JFS
18. Shri C. Mukundan, AFS
19. Shri S.J. Rajan, AFS
20. Shri A.S. Kaikini, AFS
21. Shri D.M. Purwani, AFS
22. Shri P.T. Meenakshisundaram, AFS
23. Shri K. Rangarajan, AFS
24. Shri M.H. Dulkhed, AFS
25. Shri Syed Bishoeruddin, AFS
26. Shri C.R. Sharmughavelu, AFS
27. Shri K. Venkatasubba Rao, AFS
28. Shri G. Luther, AFS
29. Shri P. Bensam, AFS
30. Shri P. Sam Bennet, AFS

31. Shri V.M. Deshmukh, AFS
32. Dr. K. Satyanarayana Red, AFS
33. Shri V. Ramamohana Rao, AFS
34. Shri A. Noble, AFS
35. Shri K.A. Narasimham, AFS
36. Dr. (Miss) M. Dharmamba, AFS
37. Shri J.C. Gnanamuttu, AFS
38. Shri V.N. Bande, AFS
39. Shri T. Appa Rao, AFS
40. Shri S. Reuben, AFS
41. Shri M.M. Thomas, AFS
42. Shri R.S. Lal Mohan, AFS
43. Shri K. Dorairaj, AFS

III. MARINE BIOLOGY AND OCEANOGRAPHY DIVISION

1. Dr. E.G. Silas, SFS
2. Dr. A.V.S. Murty, FS
3. Shri G.S. Sharma, JFS
4. Shri P.V. Ramachandran Nair, JFS
5. Shri K.N. Krishna Kartha, AFS
6. Shri C.P. Ramamirtham, AFS
7. Shri D. Sadananda Rao, AFS
8. Shri V.S.K. Chennuhotla, AFS
9. Shri N.S. Radhakrishnan, AFS
10. Shri M.S. Rajagopalan, AFS
11. Shri P. Mojumder, AFS
12. Shri G.G. Annigeri, AFS
13. Dr. C.S. Gopinatha Pillai, AFS
14. Dr. (Miss) Sumitra Vijayaraghavan, AFS

IV. CURATOR

Shri M. Kumaran

V. ADMINISTRATION

1. Shri S. Rajagopalan, Senior Administrative Officer
2. Shri A. Radhakrishnan, Accounts Officer

ABBREVIATIONS USED

SFS	- Senior Fishery Scientist	FS	- Fishery Scientist
JFS	- Junior Fishery Scientist	AFS	- Assistant Fishery Scientist
SRA	- Senior Research Assistant	JSA	- Junior Scientific Assistant
RA	- Research Assistant		
LFA	- Laboratory-cum-Field Assistant.		
